AMATEUR WORK

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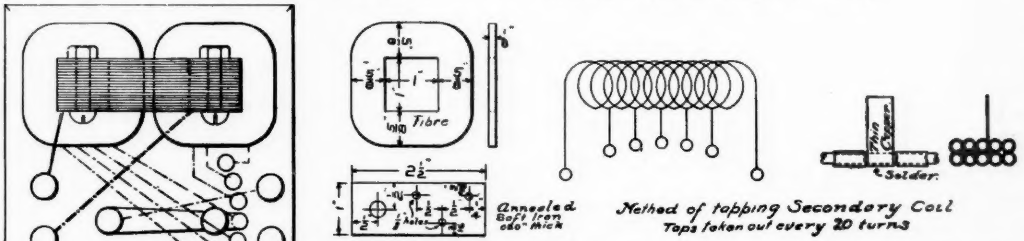
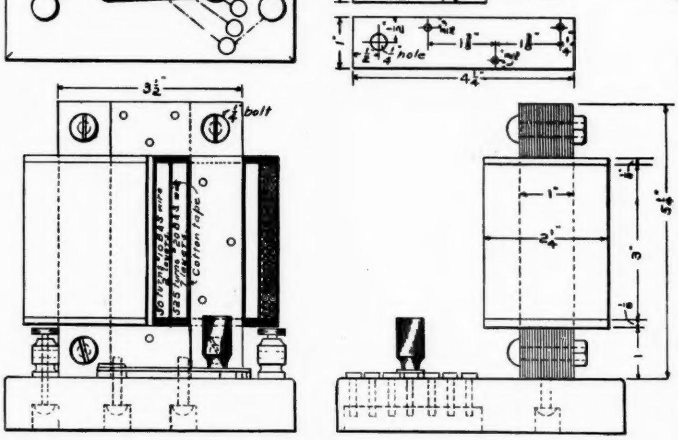
100-WATT TRANSFORMER.

R. G. GRISWOLD.

The transformer described in this article is intended for amateur construction and amateur experimentation. The materials are such that they may be readily obtained, and the entire piece of apparatus requires a very small outlay.





The capacity of the transformer is approximately 100 watts, and is designed for transforming from 100 volts to 10 volts on 125 cycles. This voltage is a very convenient one for light experimental work, and the instrument is so designed that several different coils may be wound and placed on the same core, as it is made in removable sections. The secondary is also tapped in five places, thus making it possible to obtain different voltages from the single winding.

The core of the magnets is laminated, or built up of strips of soft iron 1 in. wide by about .015 in. or .020 in. thick, and of the lengths given in the drawing. These strips are laid up, one on top of the other, until a pile 1 in. thick is built up. The strips are placed directly on top of each other, but with one end of one lapping over the lower one by 1 in, the next one lapping over by a similar space at the opposite end. This provides the ends of each section with a series of tongues and slots, which will slip into a similar arrangement on the next section. This makes a very good magnetic joint, and the several ends are clamped firmly in contact by the ¼ in. bolt running through as shown. This arrangement affords the shortest possible magnetic circuit, and also permits an in-

terchange of coils for other experiments or voltages and outputs.

When the pieces are properly laid, one on top of the other, as directed, they are riveted together by three $\frac{1}{8}$ in. rivets, as indicated. The four pieces are then bolted together and the ends finished off smoothly with a knife. Then place the four pieces, either bolted together or separate, in a fire and heat to a dull red for an hour. Remove after one hour and allow them to cool *very* slowly by burying in ashes. This anneals the iron and, while it is not absolutely essential, it is advisable to do so, as the magnetic qualities of the iron are benefited by the treatment.

The fibre washers are now forced into place. Next, wrap the two cores holding the magnet coils with cotton tape ($\frac{1}{2}$ in. wide) beginning close up against the fibre heads. The tape should half lap over itself on each turn, so that there may be no spots left bare. When the first layer is finished it is thoroughly soaked with shellac varnish and the tape carried back to the starting point in another layer, which is also soaked in shellac. The cores are now placed in an oven and baked for five or six hours, thus hardening the shellac.

The cores being completed the winding of the primary coil is begun. This winding is determined from the formula

$$\text{E. M. F.} = 4.44 \frac{\text{B N F}}{100{,}000{,}000}$$

in which

E. M. F.=electro-motive force in volts.
B=magnetic flux in lines per square in.
N=number of turns in winding.
F=frequency of cycles.

Since it is the number of turns required that is to be determined, we can solve for N by transposing

$$\text{N} = \frac{100{,}000{,}000 \text{ E. M. F.}}{4.44 \text{ B F}}$$

The frequency is generally known and in this case is 125. The magnetic flux must be taken with regard to the cross section of the core, and with this frequency it is not advisable to use a magnetic density in the core much higher than 20,000 lines per square inch. Owing to the laminated structure of our cores we can hardly count on more than 90 per cent of the total cross section, as there is always a slight space between the strips. Counting on 9 square in. the total magnetic flux through the core will be $20{,}000 \times .9 = 18{,}000$ lines. Assuming the primary voltage to be 100, we have

$$\text{N} = \frac{4.44 \times 18{,}000 \times 125}{100{,}000{,}000 \times 100} = 1{,}000 \text{ turns approximate.}$$

For an output of 100 watts, neglecting the losses and magnetizing current, the primary current would be $\frac{100}{100} = 1$ ampere, and in order to prevent overheating in the coils, the primary should have a cross-sectional area of 1000 circular mills per ampere. No. 20 B. & S. wire has an area of 1021 circular mills, so that this wire is used. This wire should be double cotton covered, which gives it an outside diameter of about .040 in. and about 25 turns can be wound per inch of core length. As each coil is to contain about 500 turns, and each layer will take 75 turns, it will require 6.6 layers to contain the number of turns, but since even layers are desirable, the last layer will be finished, making 7 layers and about 525 turns.

As each layer is wound on it is given a coat of shellac and the finished winding thoroughly baked. Then three layers of linen soaked in shellac are wrapped over the primary coil and baked until dry.

The next operation requiring attention is the secondary coil. The secondary voltage is to be 10 volts with a primary voltage of 100. The secondary current of this transformer at full load is found close enough for the present purposes from the following formula:

$$\text{S. C.} = \text{P. C.} \times \frac{\text{P. V.}}{\text{S. V.}}$$

in which S. C. = Secondary current.
P. C. = Primary current.
P. V. = Primary voltage.
S. V. = Secondary voltage.

Therefore

Secondary current$=1 \times \frac{100}{10} = 10$ amperes.

The number of secondary turns is found as follows:

$$\text{Secondary turns} = \text{primary turns} \times \frac{\text{S. V.}}{\text{P. V.}}$$

Hence for this transformer,

Secondary turns$=1000 \div \frac{10}{100}$.

Allowing 1000 circular mills per ampere, this secondary will require a cross section of 10,000 mills, which is very nearly covered by a No. 10 B. & S. wire. The 100 turns will be equally di-

vided between the two coils, or 50 turns to each, which can be wound on in two layers. These layers are also shellacked and baked after placing the taps in as shown.

These taps are made of thin copper, about No. 24 B. & S. guage and $\frac{1}{2}$ in wide. They are soldered to the primary coil on every twentieth turn, as shown in the drawing. The taps from the lower layers are brought out between the turns of the upper layer, and the leads to the switch points on the base are soldered to the protruding ends.

The arrangement of switch and binding posts on the base may be altered to suit the the requirements of the user, so no special instructions are necessary on this point; the base is made of a block of some hard wood and, as far as possible, all connections should be made beneath the base, as shown. Two $\frac{5}{8}$ in. screws should pass through the base into the lower segment of the magnet to secure it.

If the transformer is operated on 60 cycles instead of 125, the effect will be to increase the heating somewhat, but if the iron is of good quality the heating will not be large because the low density of 20,000 lines per square inch was assured. The no load current taken by the primary will be increased because a greater magnetizing force will be required to set up the magnetic flux. This will tend to increase the heating in the primary coil. The net result, therefore, of operating the transformer on 60 cycles would be to make it run somewhat warmer. Owing, however, to the intermittent load usually used in experimental work, the transformer should not run very warm. The secondary voltage would not be affected by a change in the frequency so long as the primary voltage and the ratio of primary voltage to secondary turns are not altered.

Owing to the construction of the core, the latitude of voltages of output may be easily varied by winding separate coils to slip over the cores, mounting the fibre heads on a square-formed tube of thin sheet iron.

If the primary is to be wound for 50 volts and the secondary for 10 volts, use 240 turns of No. 17 B. & S. on the primary and the same winding on the secondary, as below.

For a primary voltage of 100 and a secondary voltage of 5 with an amperage of 20, use the same winding as before for the primary and 25 turns of two No. 10 wires in parallel for the secondary on each spool.

The small transformer will be found useful for a number of purposes, especially if it is used in connection with a small rheostat by means of which the secondary current may be regulated. For operating miniature lamps, supplying current for operating small alternating-current motors or, in fact, for any purpose where a small alternating current at low voltage is required, it will be found very convenient. It is specially handy for experiments illustrating the heating effects of the electric current; it will fuse a considerable length of No. 18 wire without difficulty.

If a 5 volt secondary winding is used and taps brought out every 5 turns, it makes a good appliance for heating the cautery knives used in surgical work. The five volt secondary with taps every 5 turns, gives 10 steps of $\frac{1}{2}$ volt each, which is close enough adjustment for most work.

NOTES ON WIRELESS TELEGRAPHY.

L. T. KNIGHT.

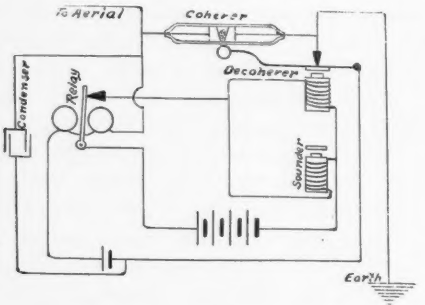
III. Receiving Instruments of a Wireless Telegraph Station.

The receiving set of a wireless station comprises the coherer, the relay, the decoherer, the sounder, the weak current and strong current batteries, coherer condenser and the tuning coil. A switch is arranged to connect the receiving set to the aerial wire when desired.

One form of coherer consists of an exhausted glass tube containing two silver plugs fitting snugly in the tube with well polished and slightly sloping ends. The space between the plugs varies from 2 to 4 millimeters in length and contains the filings of pulverized and oxidized silver and nickel alloy. The silver plugs are connected to metal tips or caps at the end of the coherer,

which serve as connecting points. The coherer is not adjustable so far as the location of the plugs is concerned, but the sensitiveness is the greatest when the narrow part of the wedge is down. But this is not always the best working position for regular receiving.

The best relay is of the polarized type, with the coils of the magnet wound to a resistence of from 4,000 to 10,000 ohms. The relay must be well balanced, absolutely sure in action and quick to start. A first-class relay will operate with one volt difference of potential through a resistance 50,000 ohms.



The decoherer is a high frequency vibrating hammer constructed on the ordinary vibrating door-bell principle. The weak current battery used in the coherer operation is a dry cell of very low amperage and one to one and one-quarter volts. The coherer condenser bridges the relay windings and battery, is of very small capacity, and when properly placed serves to shut off any static charges that might flow in from the aerial wire to and through the coherer and relay and prevent operation.

The sounder is the ordinary Morse device, operated by several cells of dry battery. The tuning coil is a variable contact device patterned after the one described in the previous chapter.

The adjustment of receiving instruments requires care and patience, particularly in the relation of the relay and coherer, and the sounders and the decoherer. The sensitivity of the coherer varies with the degree of oxidization of the silver-nickel fillings, as well as the size and distance between the plugs. The normal resistance of the coherer is very high and the amount of current from the little dry battery is not sufficient to pass through to the relay windings. But when the wave enters by way of the aerial wire this high resistance is broken down by the critical potential and becomes approximately about 3,000 to 5,000 ohms. In this state the current is allowed to pass into the relay circuit and operate the relay. This, in turn, throws in the sounder and the decoherer, the circuits of which are shown in accompanying sketch. When the decoherer operates the relay circuit is opened and the relay returns to its normal position, and of course at the time the decoherer operates the sounder also operates. The decoherer is more active in operation than the sounder, and this permits the relay and decoherer to cause the sounder to give dashes as well as dots.

ELECTRIC LIGHTING OF CHRISTMAS TREES.

FREDERICK A. DRAPER.

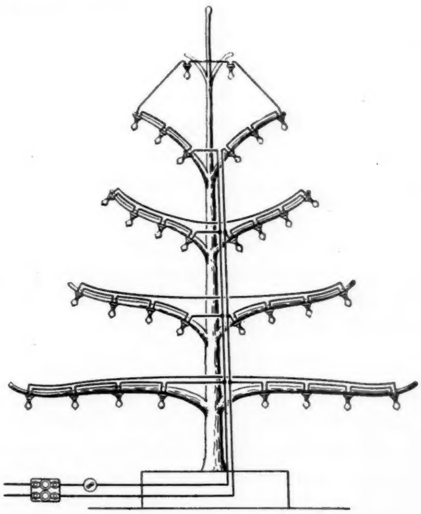
The greater safety attending the lighting of Christmas trees by electricity makes this method far preferable to that of the familiar candles, with the possibility of igniting the inflammable trees and decorations. By following the directions here given any one possessing ordinary skill can make and arrange the necessary fixtures to produce a very pleasing effect, and at a most reasonable expense.

The first consideration is the source of current; whether from the lighting circuit in a building lighted by electricity or, where such current is not available, by battery. The former will first be described, but before doing so it is well to mention that in some places the restrictions imposed by insurance authorities are very stringent and should be ascertained before commencing work, that the regulations may be properly complied with. Where battery current is used this trouble is avoided, as the current is of such low potential that no trouble would follow should short circuits occur, other than a quick exhausting of the bat-

tery and a failure to keep the lamps up the proper brilliancy.

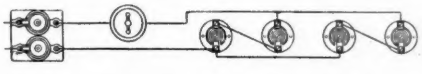
Assuming that the current is to be taken from the wires of a regular incandescent lighting circuit, the voltage of which is between 108 and 112 volts, the first requisites are: Plugs for the sockets in which the lamps are affixed; enough two cord flexible wire to reach from the socket to the base of the tree; 100 feet or more of annunciation wire, divided equally between two colors to facilitate wiring; the necessary number of 14 volt *series* miniature bulbs of 3 C. P. and an equal number of porcelain sockets.

An examination of the tree having been made and the location and number of the lamps decided upon, a wiring diagram should be drawn showing the wires, lamps and connections, as it will probably be necessary to run the connecting wires from one branch to another to make up the complete circuits of eight lamps each. It will be noted that eight 14 volt lamps, "connected in series" make a total voltage of 112 volts, a slightly less voltage of the main circuit having but little effect on the several lamps. For each eight lamps on the tree, therefore, a separate plug and connecting wires will be required, unless one is sufficiently skilled in wiring to make a double connection and circuit through one plug, in which case other lamp on the same line circuit should not be turned on, to avoid overloading the line. All joints should be soldered and well insulated with electricians tape, except at the sockets, where a complete turn of the wire around the screw will answer, but at these points care should be exercised that the ends of wires are separated sufficiently to avoid short circuits. The lamps should be located in open spaces to secure the maximum effect and be visible to as large a portion of the room as possible, the general arrangement being that of a pyramid. A defective lamp will prevent the lighting of all and will have to be located and replaced with a good one when all will be illuminated. The number of lamps required will vary with the size of the tree; a small one requiring at least eight, and double the number can be used to advantage, and a large one is only limited by the time and money which may be available for the purpose. Colored bulbs add much to the effect; three red and three green for each ten white ones being a good proportion, the colored giving less light than the white ones. Directions for coloring bulbs were given in the January, 1903, number of this magazine, so will not be repeated here.

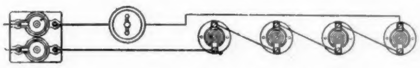


Where a commercial lighting circuit is not available and resort must be had to a battery current, the type of battery most suitable and easily constructed is that known as the bichromate plunge battery. The one described in the May, 1903, number, with an additional pair of plates, will be found satisfactory. The only alterations will be to lengthen the box $5\frac{1}{2}$ in. If made for only temporary use, exact work is not needed other than to make sure that the joints are perfectly

Multiple Arrangement for 8 C P: Multiple Lamps.



Series Arrangement — Two Lamps in Series.



Series Arrangement — Four Lamps in Series

tight. One battery as described will furnish ample current for about 24 1-C. P. 14 volt lamps connected in multiple on three separate circuits, the leads for each circuit being connected to the terminals of the battery which is connected in series, giving a full 14 volts. It will be necessary

to have the windlass attachment so that as the current is continued the zinc plates may, at intervals, be lowered into the solution. At first the zincs should be lowered only sufficiently to bring the lamps to the full brilliancy, and there remain suspended until the lamps begin to dim slightly, when a little further lowering of the zincs will immediately bring them up again. On this account it will be advisable to have the battery located under the tree, concealing it with paper or other decorations. The necessary supplies for all the fixtures, including thebattery can be ordered through any large electrical supply house, though it is probable that the battery parts will require a little time for filling the order and should, therefore, be ordered sufficiently in advane of the time wanted to avoid disappointment.

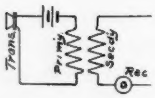
NOTE.—Any one having difficulty in securing the supplies for the above work can, by communicating with the editor, obtain the names of firms from whom they may be ordered.

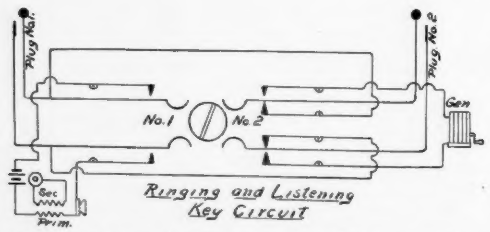
TELEPHONE CIRCUITS AND WIRING.

ARTHUR H. BELL.

VII. Central Station Systems.

In the last chapter was described the subscribers' drop and jack wiring. An illustration is here shown of another form of key for the cord circuit which has decided advantages over the one previously mentioned, in-as-much as the operator is enabled to answer a call with one cord of a pair, make connection with the party desired with one movment of the key, and listen in on the line when desired.





The key here shown is constructed of spring-brass strips and silver contacts. The circular plunger between the strips is actuated by a pivotal handle, so that the operator may at will force the plunger between the strips, thereby opening off one circuit and connecting with another. The plugs are what is commonly described as two part plugs and are connected to the key springs exactly as shown in the drawing. When the drop falls, thereby signalling the operator, the plug No. 1 is inserted and conversation established by pressing the cam lever so that the plunger is forced between the No. 1 springs and away from the springs of No. 2 for the time being, placing the transmitter springs in contact. When party No. 1 is to be connected with the party called, the plug No. 2 is inserted in the desired jack and that party signalled by again moving the ringing key, but this time in the opposite direction, and ringing on the line by whatever device may have been provided for the purpose. Then the plunger is released and when in the normal position party No. 1 is in communication with party No. 2. The operator may at any time throw her set in upon the line and enter into conversation.

The operator's set consists of the primary side of a telephone induction coil in series with battery and a transmitter. The receiver circuit comprises the scondary of the induction coil, closed through a telephone receiver. It must be remembered, however, that there are many styles of keys used in connection with cords of a switch board, each possessing some particular fitness for the circuit involved. There is one drawback to the one here described, as the operator can ring on only one cord of a pair and, the receiver being in the secondary circuit, there will be a va-

riance in the hearing qualities, all of which can be perfected according to the ingenuity of the amateur electrician, who will find it greatly to his advantage to construct one of these circuits in his workshop.

Often times it is not desirable to place the transmitter set directly upon the line, and recourse is taken to a modified form of the induction coil, in which the transmitter, battery and primary winding constitute one side of the set and the secondary winding, in series with the receiver, becomes the side which is placed directly upon the cord circuit when the key springs are actuated by the plunger. A condenser of low capacity might also be connected in parallel with the receiver in the secondary and benefit transmission.

The induction coils in common use in transmission are constructed of No. 23 D. C. C. wire wound in turns about an iron core to a resistance of about one and one-half ohms. The secondary is of much finer wire, preferably No. 36, wound in turns over the primary, to a resistance of at least 150 ohms. Such a coil is adaptable to long distance transmission where the potential raising value of the secondary is sufficient to overcome the resistance of the line and equipment. For strictly local usage it may be desirable to use No. 28 wire in the secondary and wind to a resistance of 10 ohms in the primary and 20 in the secondary, the exact efficiency being found by experiment.

In the next chapter will be described a few circuits pertaining to central energy work, where all the signalling and talking battery is derived from a central supply instead of batteries and generators being required at each telephone.

ELECTRIC CAPACITY.

JOHN E. ATKINS.

There is a property inherent in electrical circuits which plays an important part in the amount of current. This property is called capacity. All conductors will absorb and hold a certain quantity of electricity, and one of the simplest illustrations of this is the Leyden jar, familiar to all students. When the terminals of a Leyden jar are connected to the leads of a strong generator, a certain amount of current appears to flow into the jar and become absorbed, and it is a common experiment to "charge" these jars and discharge them at will by touching the terminals together.

This ability to store electricity is called capacity, and by experiment we learn that a number of things beside the electric current used in the charging, contribute to the capacity. First, as will be readily inferred from the experiment with the Leyden jars, the larger the jar, that is, the greater the tin foil surface, the greater the capacity. Second, we must consider the voltage of the charging device; the greater the voltage, the greater the saturation. Third, the composition of the medium used as an insulator between the metallic surfaces of the condenser. Fourth, the distance one of these metallic surfaces is from the other, that is, the thickness of this insulating medium.

But it must not be construed from the foregoing that the "volume," that is, the thickness of the *metallic* substance is a factor in capacity, for it is believed that the electricity is not held in the metal itself, but is stored upon the insulating medium used in building the condenser. This may be proved by constructing a simple condenser of two tin plates and a piece of glass and, after charging, remove the plates with an insulated handle, and not until they are returned to the original position will there be any manifestation of electricity. Believing this to be the case in all condensers, it is easy to presume that the capacity is proportional to the area of the conductor and not to its volume.

And it is easy to understand that the capacity of a condenser is inversely proportional to the thickness of the insulating substance separating the metal plates, that is, in constructing a Leyden jar one would choose a glass jar of thin wall instead of one of extra thick glass, because thick glass would separate the metallic surfaces at such a distance from one another that very little induc-

tion could take place from one to the other.

In low voltage work, where the voltage is less than will cause a spark to jump through a thin insulating medium, paraffine waxed paper serves very well as condenser material, not only because of its excellent insulating qualities, but because of the large surfaces of metal that can be brought close to one another without touching. And to obtain the maximum capacity with a minimum of expense and bulk, most of the condensers in the market are made of paraffine paper and thinnest tin foil. The best standard condensers are made of mica sheets and metal foil, and are much more expensive than the paraffine paper ones.

When we consider the subject of condensers to be connected for capacity affects across a circuit of high voltage, such as the secondary of an induction coil, for instance, it would never do to use one of waxed paper, because the paper would puncture at the very first discharge.

So we must resort to sheets of glass of the right thickness, or mica sheets stuck together with paraffine or shellac.

The current from the secondary may be presumed to be alternating, and when the secondary terminals are connected to a properly designed condenser, the condenser sheets are alternately charged and discharged as the direction of the current changes. And the application of a condenser across and in parallel with the spark gap of an induction coil, provided the condenser is of the right capacity, will greatly increase the fatness of the spark discharge and, proportionately, cut down its length.

PATTERN MAKING FOR AMATEURS.

F. W. PUTNAM.

X. A Small Jack. — A Small Hand Wheel.

Fig. 61 shows the castings and Fig. 62 the pattern for a small jack requiring a balanced horizontal core. A split pattern is used, and is turned in the same manner as the pattern for the recessed cylinder previously described. It will not be necessary to go into a detailed account of this pattern, and I shall confine myself to a few simple directions which may aid the amateur in easily constructing the pattern.

Be very certain that the two blocks which are to form the pattern are planed to a smooth, even surface, so that when they are dowelled and clamped together there will be a perfect joint formed. Care should be taken in locating the centers for the dowel holes, as well as in seeing that the holes are not bored too deep into the second block. That block, when ready for turning, should be very carefully centered in the lathe so that the pattern when spread apart will have both faces equal. The core-box for this pattern is shown in the isometric drawing, Fig. 63. Six blocks are required to form this core-box, as can be readily seen by reference to the figure. *A* and *F* are simply the end pieces, and are glued and nailed to pieces *B* and *E*. The pieces *B*, *C*, and *E* are to be cut out and finished with a gouge, the same as for the core-box for the recessed cylinder previously described. The piece *D* is $\frac{1}{8}$ in. thick, and can be readily brought to almost the required shape with a sharp knife, the surface being finally finished with file and sand-paper. When the six pieces are to be fastened together, see that the centers of each and of the blocks come in one straight line. If this not done the core made from the core-box will be very likely to leave an uneven center in the casting.

If we look at Fig. 61 we will notice that the hole does not run way through the casting, it being intended that the top hole shall be drilled out after the casting is made. This leaves one end of the casting solid and so a balanced core is necessary.

No absolute rule can be given for the relation of length to diameter in the case of the projecting core print. It will be found that the dimensions given in Fig. 62 are in about the right proportion. This proportion works so as to give the length as about two and one-quarter times the di-

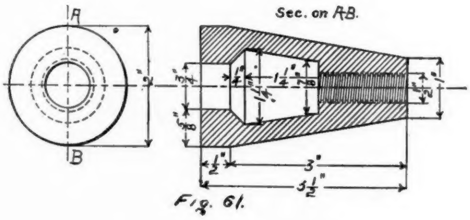


Fig. 61.

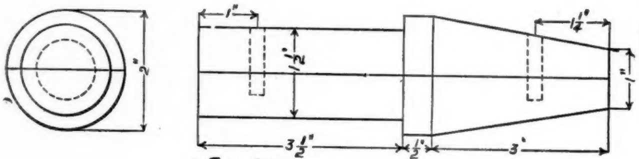


Fig. 62.

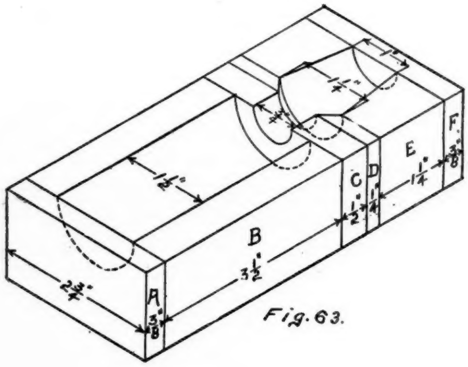


Fig. 63.

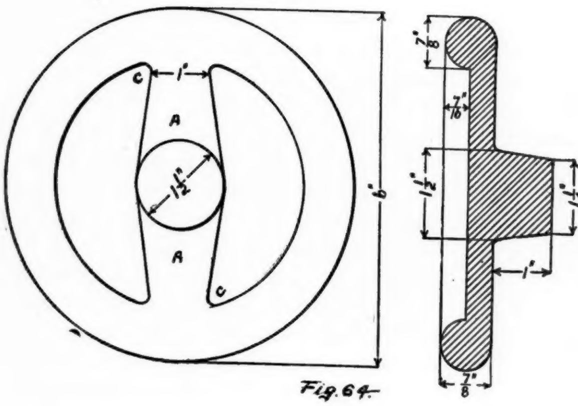


Fig. 64.

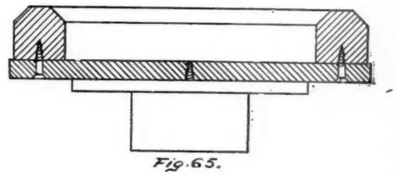


Fig. 65.

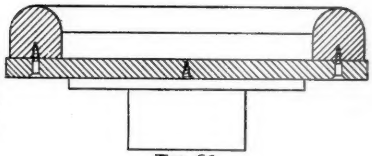


Fig. 66.

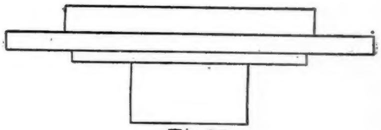


Fig. 67.

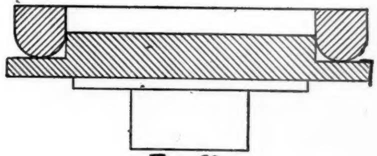


Fig. 68.

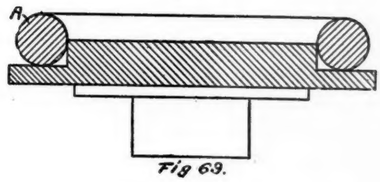


Fig. 69.

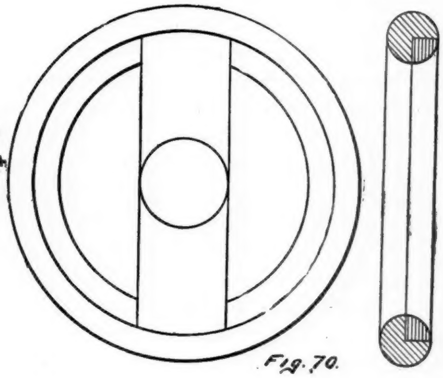


Fig. 70.

ameter. It will be found by trial that for a pattern of this size any smaller ratio is insufficient.

The core-box is a half core-box only, and so two half cores are made, baked and then pasted together. The largest diameter of the core is 1½ in. while the smallest diameter, which comes not very far from the middle of the length of the core, is but ¾ in.; so that it becomes necessary that extra care be taken in finishing the various pieces forming the core-box in order that the sand forming the core can be easily removed from the core-box without breaking away in the slightest degree. Of course small wires could be used in making these cores to aid in holding the sand.

Fig. 64 shows the drawing for a small hand wheel so constructed that the rim may be built separately, the arms, *A*, Fig. 64, being inserted after the wheel is built. First, cut from a piece of clear, dry pine 1 in. thick a circular block 6$\frac{3}{16}$ in. in diamter. Fasten this carefully to the square center plate, and first true up the front surface of the block. Prepare some pine stock ¾ in. in thickness and lay out on this board quarter circles to be used for building up the rim, allowing ½ in. extra stock for turning. The outside radius, therefore, should be about 3¼ in., and the inside radius about 1¾ in. Carefully saw out this segment and, using it for a pattern, mark out seven other pieces and saw them out to the lines. These segments are to be joined endwise around the circumference of the wood face-plate previously turned. Be sure that each two segments meet in a perfect joint. The edges are to be carefully glued together, and the segments are fastened to the face-plate by screws of small wire brought through from the back of the face-plate. It will, of course, be necessary to put a layer of paper (either brown paper or newspaper is good for this purpose) between these segments and the face-plate. Otherwise the rim would become glued to the face-plate and could not be removed after the turning was completed.

Having completed the first set of segments, put the face-plate on the lathe and turn the front face of the segments true. The other four segments are next glued to the first set, comprising what is known as the second course. These segments should be placed so that the joints will not come directly over the joints of the first set. In other words, the second set of segments will lap over the first, forming a lapped joint. This second course is fastened to the first form with glue, and must be clamped together until the glue is thoroughly set.

Next, place the face-plate on the lathe again and remove the front surface of the second course of segments until the required thickness, $\frac{7}{16}$ in. is reached. The outside diameter, 6 in., is next turned, and the inside diameter made 4½ in. The corners of the segments are then cut away with a skew chisel so as to form the circular groove required in Fig. 64. Fig. 65 shows the corners removed, and Fig. 66 shows the required half circle.

Carefully sand-paper the pattern when this work has been completed, and next remove the screws which fasten the wood face-plate. The wood face-plate is next to be turned down until the shape shown in Fig. 67 is reached. The pattern is then to be forced on to this face-plate, as shown in Fig. 68. The outside corners are next to be removed, so that finally the pattern will take the shape shown in Fig. 69, when it is to be sand-papered. Before the pattern is removed from face-plate, make a line at the point marked *A*, Fig. 69, with the acute point of the skew chisel. This line is to be used later in centering the hub. By this I mean locating the center of the hub on the arms after they are inserted in the pattern. The arms are made from stock $\frac{7}{16}$ in. in thickness and 1¼ in. wide.

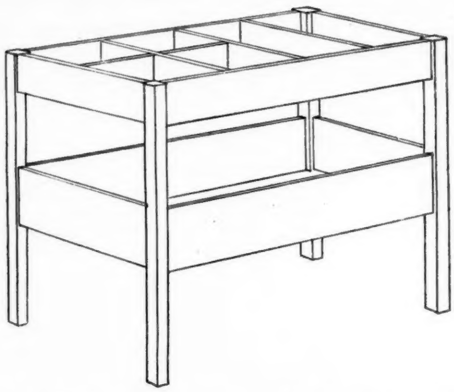
Having set the dividers at the radius of the circle marked on the rim, make lines on each end of the piece to be used for the arms, these lines corresponding with the centering circle. Carefully cut out the block on these lines, and next place the arm in position on the rim, marking out the edge of the piece so as to outline the rabbet or pocket which must be cut in the rim in order to receive the arms. Next, cut down to this centering circle and to the other lines, those marked rabbet or pocket being cut half way through the rim. This piece is next set in position, as shown in Fig. 70. The hub, as shown at *B*, Fig. 64, is now to be turned to the required dimensions. A shoulder may be turned on the hub and a corresponding hole bored in the pattern, or the hub may be simply fastened with glue and nails to the outside surface of the pattern. Finally, cut down the arms to elliptical form, as shown in Fig. 64. The pattern is then to be sand-papered and shellacked.

EASILY MADE FURNITURE.

JOHN F. ADAMS.

A SEWING TABLE.

The sewing-table here described will be found a convenient receptacle for the numerous odds and ends required for the household repairing and dressmaking. It is of light construction permitting of being easily carried about the house, and yet has abundant room in its several compartments for the separate storage of buttons, thread, yarns, etc., in the upper part, and the



work in the lower one. Gum-wood is recommended with which to construct it, being of fine, even grain, sufficiently dark not to soil easily and presenting an attractive appearance with a natural finish. The required stock is as follows:

4 pieces	30	in. long	and	1	in. square.	
2	"	$28\frac{1}{2}$ in.	"	"	4	in. wide.
2	"	$18\frac{1}{2}$ in.	"	"	4	in. "
4	"	$18\frac{3}{4}$ in.	"	"	$3\frac{5}{8}$	in. "
2	"	$28\frac{1}{2}$ in.	"	"	6	in. "
2	"	$18\frac{1}{2}$ in.	"	"	7	in. "
2	"	$28\frac{3}{4}$ in.	"	"	$18\frac{3}{4}$	in. "
1	"	32 in.	"	"	21	in. "

All the stock, except the corner posts, is $\frac{5}{8}$ in. thick. The wide pieces for the top, and the bottom boards of the trays will have to be glued up.

The illustration shows pretty clearly the method of construction, but gives the appearance of a larger table than it really is. The side pieces are mortised into the posts, full size, to a depth of $\frac{1}{4}$ in., the space between the upper and lower trays being 7 in. These pieces are also set in $\frac{1}{4}$ in., as shown. The upper tray is divided into four sections with cross-pieces, and two of these sections are again divided, making six pockets, but any other arrangement can be adopted that the maker chooses. These divisions are made with the strips $3\frac{5}{8}$ in. wide, thus allowing $\frac{3}{8}$ in. on the under side for the bottom board, measuring $28\frac{3}{4}$ in. which is nailed through from the sides and ends and also into the division pieces. The bottom of the lower tray is nailed in places in the same way.

The top is strengthened with cleats at each end placed so as to fit snugly inside the end pieces thus holding it in position when on, and yet allowing it to be lifted with work upon it, without being obliged to remove the latter, as would be necessary with hinges.

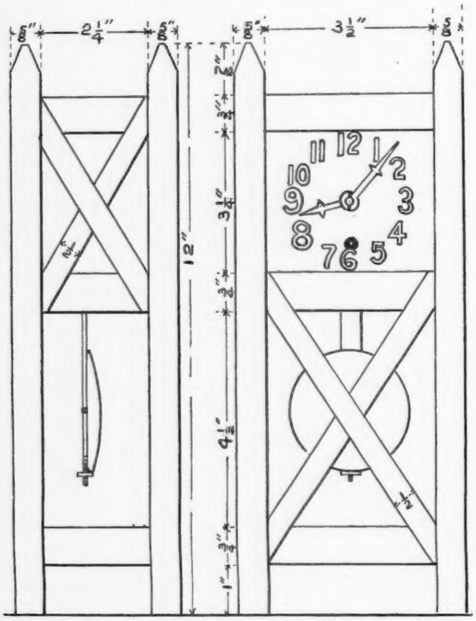
A MANTEL CLOCK.

The design here given for an old Dutch mante clock is suitable for making up for a Christmas present, and on that account will undoubtedly be welcomed at this time. The movement for which the dimensions are given is an eight day, front winding, $3\frac{1}{2}$ in. pendulum movement of low cost, manufactured by the Seth Thomas Clock Co., Thomasville, Conn., but any other movement about this size can be used. That of an ordinary alarm clock will do, if the absence of the pendulum is no objection, though this adds much to the appearance. The wood should be oak, stained a dark green or brown, as preferred.

The dimensions of the various parts are clearly shown in the illustrations. The cross-pieces are mortised into the posts about $\frac{1}{4}$ in., and are set back $\frac{3}{16}$ in. from the outer edges of the latter. The diagonal cross pieces on the front and sides are $\frac{1}{8}$ in. thick and nailed to the cross pieces with escutcheon pins, with the inner ends bent over to hold securely.

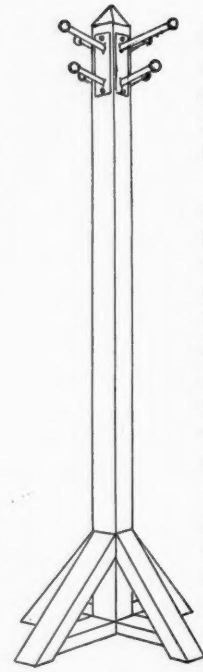
The case for the works is made from thin stock

the bottom being left open. The dial is also made from a piece of thin stock, stained to match the rest of the frame and is held in place by small, round-head brass screws, one in each corner, which are put through the dial into blocks fastened to the sides of the case to receive them. The works have lugs at the back for fastening to the back of the case with screws, and should be put in place before fitting the dial. Care should be taken that the works are exactly "in beat" when in place, otherwise the clock will not run satisfactorily.



The figures on the dial can be cut out of thin white holly with a fret-saw, or pattern makers' metal figures may be used, but the latter are liable to tarnish. Lacquered brass figures are desirable when same can be obtained. They should be of the size known as $\frac{1}{4}$ in. Gothic; the spacing can be taken from any clock, a circle being marked with dividers. The pendulum should be stained with the same stain as that for the frame, and a thin strip $\frac{5}{8}$ in. wide attached to the wire pendulum rod with glue, which also should be stained. A wax finish is most suitable, but an oil and varnish finish may be used if desired.

A CLOTHES TREE.



A very convenient piece of furniture is easily made, and any one in need of it will welcome it as a holiday gift, even if the maker is also the recipient.

The post is 4 ft. 6 in. long and $2\frac{1}{4}$ in. square. The top is mitred, as shown, and the bottom is cut down to form a tenon $\frac{3}{4}$ in. square and $1\frac{1}{4}$ in. long. The four legs are 15 in. long, $2\frac{1}{4}$ in. wide and $1\frac{3}{4}$ n. thick, and cut to a bevel to fit the post, the upper edges of which are $8\frac{1}{2}$ in. from the extreme lower end of the post.

The cross pieces under the post and connecting the legs are 16 in. long, $2\frac{1}{4}$ in. wide and $1\frac{1}{4}$ in. thick ; the joint under the post being halved and tenons cut on the ends $\frac{1}{2}$ in. wide and the full thickness of the pieces. The lower edges of the mortises for same in the legs are 3 in. from the ends. A mortise $\frac{3}{4}$ in. square is cut in the center for the tenon on the foot of the post. These mortise joints are pinned with $\frac{1}{8}$ in. dowel pins, holes being carefully bored for same, and good fits secured to make them as inconspicuous as possible. The clothes hooks at the top should be of black iron if same can be procured; otherwise use square wooden rods $\frac{1}{2}$ in. diameter with 1 in. bottons on the ends. The finish should be dark brown or green stain, rubbed out to show the markings of the grain, with wax or rubbed oil finish.

The amateur pattern maker is quite likely to experience trouble in his first attempt at mixing lampblack and shellac, owing to the tendency of the former to form lumps, thus preventing a thorough mixture of the two ingredients. If the lampblack is first made into a soft paste with alcohol, thoroughly working out the lumps with a wooden or metal spatula, the shellac can then be added and a smooth working shellac result.

PHOTOGRAPHY.

CHRISTMAS SUGGESTIONT.

A brief resume of what can be easily and quickly done in a photographic way for making up attractive Christmas gifts, will, it is hoped, be of interest to those who, having a camera, have not as yet passed beyond the "press the button" stage, and consequently know nothing of the delights, as well as tribulations, of developing, printing, toning, etc. It may possibly come to pass that there will be those who, reading these lines, will be encouraged to attempt one or more of the simple processes here mentioned, and, meeting with the success easily possible, be thus encouraged to more serious and instructive work. Let us hope.

The ever present evidence of a frugal correspondent, the postal card, is at once the easiest and cheapest way of sending a Christmas greeting, and when bearing the portrait of the sender, friend or relative, or a landscape which recalls pleasant or historical associations to the receiver, is very effective. Cards already sensitized and ready for printing from the negative can be purchased in packages. Velox cards giving a black print and printing by gaslight, and sepia cards giving a brown print and printing by sunlight, are to be found at about all supply dealers. Complete directions for using are given on each package.

A variation of the above mentioned photo-postals is that of cards with embossed borders and a place for mounting a print 2½ x 1½ in. in size. These are to be had in different colors and patterns of embossing and are very attractive.

The sensitizing solution for paper or cloth is not new but is mentioned, as it may be suggestive of new applications to some readers. Correspondence paper, envelopes and calendar mountings are the most popular channels for ts use at present. For a blue print it is to be had in powder form, requiring but the addition of water; for the silver print (brown) it is in liquid form. As applied to correspondence paper it can be used to uce the most novel and pleasing effects, and is limited solely by what may be possible with the camera in use. For those sufficiently familiar with photographic processes to make up and use their own solutions, the following formula is given:

Light Sensitive Postal Cards.—Apply the following solutions to the cards with a brush:

Iodide of potassium	1.6 g.
Bromide of potassium	6 g.
Arrowroot	2 to 2.5 g.
Distilled boiling water	120 c.cm.

When the cards are dry float them in the dark upon a 5 per cent. nitrate of silver solution. When dry they are ready for printing. If exposed in artificial light, they require about a second. Rodinal is best for development.

Another formula is:

Nitrate of silver	1 g.
Nitrate of uranium	10 g.
Alcohol	40 c.cm.
Distilled water	10 c.cm.

The washed print is put into a weak muriatic acid solution, and is finally washed for 30 minutes in running water.

As a suggestion for a useful and accceptable present for any novice in photography may be mentioned an "exposure metre" or scale, by means of which the length of exposure may be accurately determined for all kinds of weather, hours of the day and rapidity of plates. The Wager scale, sold for 50 cents, is probably best adapted to beginners, as it is complete in itself, requiring no print paper preliminaries; simply sliding the several sections to agree with the conditions existing will, after a few trials, enable the length of exposure to be accurately determined. The matter of correct exposure is a more vital matter than beginners generally think it to be, and not until its importance is realized to the extent of studying the degree of light prevailing, will correct exposures be the rule rather thau the exception. It is because the simple device above mentioned can be of so much value to a beginner, and even one of some considerable experience that it finds a place in this list of seasonable suggestions.

AMATEUR WORK.

DRAPER PUBLISHING CO., Publishers,

88 Broad St., Room 522, Boston, Mass.

A Monthly Magazine of the Useful Arts and Sciences. Published on the first of each month for the benefit and instruction of the amateur worker.

Subscription rates for the United States, Canada, Mexico, Cuba, Porto Rico, $1.00 per year.

Single copies of back numbers, 10 cents each.

TO ADVERTISERS.

New advertisments, or changes, intended for a particular issue, must be received at this office on or before the 10th of the previous month.

Entered at the Post Office, Boston, as second class mail matter, Jan. 14, 1902.

DECEMBER, 1904.

The interest shown in magic-lantern work by many of our readers leads us to propose the following plan for an exchange of lantern slides: Any subscriber may send their name and address and a list giving the subjects of three slides, of which the owner will send duplicates in exchange for other slides desired by him. These addresses and lists will be published as received, and those interested can then correspond directly with those having slides which they desire. In addition, anyone may send in a list of slides wanted, but the latter lists will be limited to not over five in any single month. The subjects for exchange should be those most likely to interest the largest number.

To present the matter so that readers may obtain a correct idea of the slides, we will offer the following monthly prizes for photographs of the most interesting subjects which the competitors have for exchange:

First prize, Premiums given for three new subscriptions.

Second prize, Premiums given for two new subscriptions.

Third prize, Premium given for one new subscription.

In awarding the prizes, the subjects of the slides, the excellence of the photographs and resulting slides will all be considered. For that reasan, we reserve the right to request competitors to send slides when the rendering of an award may require it. This department will be confined strictly to an exchange of slides, and sales of slides will bar those engaging in it from the publication of their lists.

The approach of the holidays and the near advent of another year is usually the occasion for forming new resolutions for improvemeut in some way best known to ourselves, and we, like our readers, have certain thoughts in this line. We hope to make this magazine of greater interest and value than in the past, and most earnestly request suggestions regarding subjects of interest, which will be utilized in the preparation of articles, so far as it is possible to do so. In turn, we hope our readers are utilizing the information and directions presented in the sucessive numbers to some practical purpose, thereby increasing their fund of knowledge and experience, which cannot prove other than of direct value, even if the way of it may not at the time be evident. It is the acquiring of a large stock of miscellaneous information on many subjects which distinguishes the ingenious and skilled mechanic from the ordinary workman, and makes the former in demand when the latter can find no opening. To help those who would help themselves is one of the chief aims of this magazine.

Mr. Heit, a French inventor, has recently patented a compass which automatically registers minute by minute. The compass card is fixed on a steel pivot. which rests on a fixed agate, instead of having at its center an agate resting on a fixed steel point. The fixed agate is immersed in a drop of mercury, which serves as a condnctor for the electric current that causes the movements of registering.

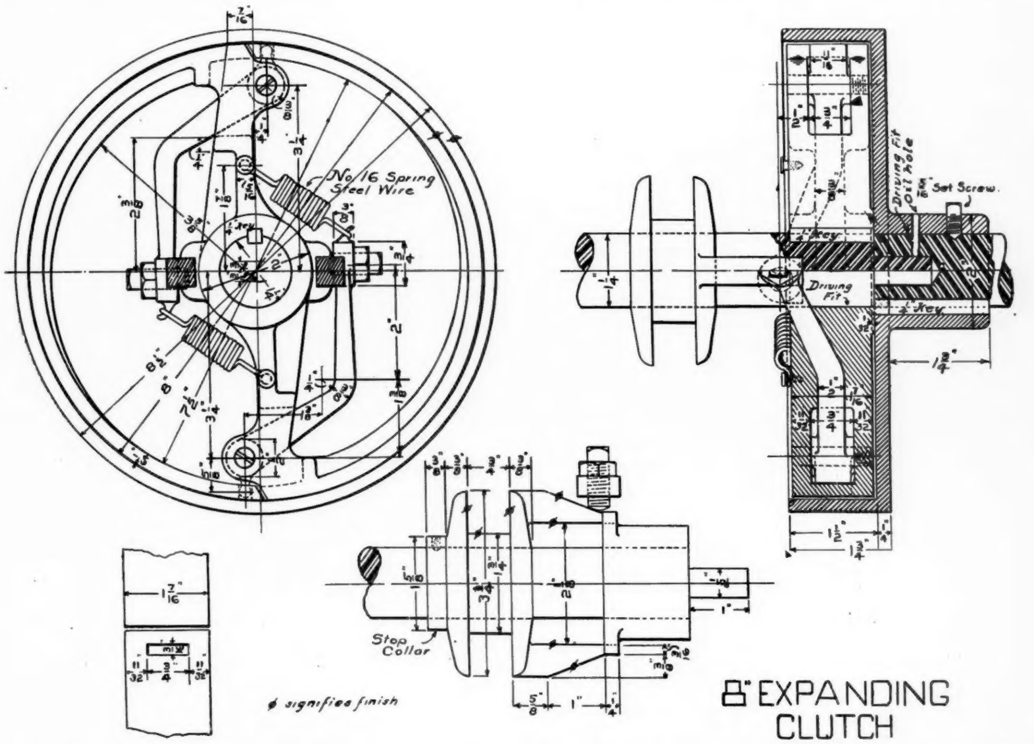
A GASOLENE TOURING CAR.

R. G. GRISWOLD.

II. Eight Inch Expanding Clutch.

The object of a friction clutch is to provide a ready means of throwing a machine or other mechanical device either into or out of engagement with the source of power. The requirements for the general run of clutches are sufficient area of contact surface to cause the two engaging parts to hold without undue pressure ; ability to engage slowly and without taking hold suddenly, depending upon the pressure used, and sufficient strength to transmit the full power required without slip.

But with this design of clutch, which is used to a great extent on automobiles, it is necessary to make it of very large diameter in order that it may hold the load. The cone is generally forced into engagement and held there by a spiral spring, the pressure of the foot on a lever releasing the cone and pushing it back clear of the seat. These clutches depend for their successful action upon the condition of the leather or other lining material, and the presence of oil on the surface lessens the friction very considerably. Then, if



8" EXPANDING CLUTCH

the clutch is thrown in slowly, the swiftly revolving surface generates sufficient heat to burn the lining, or at least to glaze it and render it unfit for service. Where it does act well, however, it is a very satisfactory device, but can be very easily injured.

The number of designs is legion, and many of them are exceedingly clever, but the simpler a clutch may be made generally the better. The fewer parts used, consistent with the work required, the fewer joints there are to wear loose and rattle. Perhaps the simplest design is that of the cone fitting into a similar cone, either piece being lined with leather or other similar material, or finished contact surface being left so as to work metal to metal.

With a clutch operating metal to metal, the surfaces in contact may be coated with a film of oil or other lubricant which will prevent their cutting during the periods that slipping does occur, as it always does

when the clutch is thrown in. But the greatest feature, probably, of any metallic contact-surface clutch is the positive action that may be secured with greater ease than on conical types held in by the action of a spring. For instance, the clutch about to be described can be expanded with such pressure that the keys in the shaft can be easily sheared without slipping the two members, and some recent experments with this particular clutch positively determined its excellence.

A shaft was fitted in a lathe carrying one of the members. In the clutch was fastened the driving member. The back gears were thrown in and the belt put on the largest cone, giving a tremendous pull. The lathe was started and tests made to determine the holding power of the clutch. As the sliding cam was pushed in with a tool held in one hand, the friction began to increase with a perceptible slowing down of the spindle, and when the cam was forced entirely home the lathe was stopped and the belt slipped off the pulley. The test was especially severe as the speed of rotation was very low, not more than ten or twelve turns per minute, while the clutch is designed to transmit about twenty-horse power at 1,000 revolutions per minute. One feature was very noticeable, and that was the readily controlled grip. In a great many clutches, it is difficult to throw them in easily as they take a full grip or none. As the cam was thrown in the expanding ring gradually took hold and the slipping was smooth and without cutting, owing to the lubricated surfaces. Very little pressure was required to operate the cam, and the pressure of a finger would make the clutch grip, while very little more served to lock it fast.

The driving member is a plain drum of cast iron, turned on the inside and outside peripheral surfaces. It is keyed to the engine or other driving shaft by a 5-16 in. key two inches in length. It is also further secured from slipping by the ¼ in. set screw shown.

The expanding member is also of cast iron, and consists essentially of a ring of metal carried by a spider. This spider is also keyed to a shaft, and this shaft is provided with a ½ in. journal running in a bearing in the driving shaft. This serves to center the inside ring which has about 1-64 in. clearance. As the clutch is generally engaged, leaving very little time when the engine is running idly, there is little work for this bearing to do, hence little chance for wear or cutting. It is, however, provided with a Babbitt metal lining, and the hole is continued to a sufficient depth to allow a lump of some bearing grease to be put in before assembling. Should the bearing begin to heat from any cause, this grease will melt and lubricate the surfaces. An oil hole is also drilled and provided with a screw plug for ordinary oiling.

This ring is entirely finished before cutting apart at the points over the levers, which is accomplished with a hack saw. The pins upon which the levers turn should be hardened and are held in place simply by a small split-pin. The levers are simple forgings of steel. It would be unwise to use cast iron for this purpose, owing to its comparatively low tensile strength. The forgings are very simple, however, and can be easily made by any blacksmith. They are provided with hardened set screws and jamb-nut for adjustment ; the end of the set screw is rounded and polished where it bears on the fingers of the cam.

The cam has been provided with exceptionally large thrust surfaces to take care of wear. This is necessitated by the high speed at which the clutch runs. It was primarily designed to be held in by a spring and released by lever pressure, but the reverse may be just as easily done. The throw of the cam is 1¼ in. and a small flat is left on each finger to form a positive rest for the lever in case the cam is not spring-actuated. Each lever is attached to a stiff spring, which overcomes the centrifugal action. Were these not provided it is possible that some difficulty might be experienced in releasing the clutch at high speed owing to these levers flying and remaining in that position.

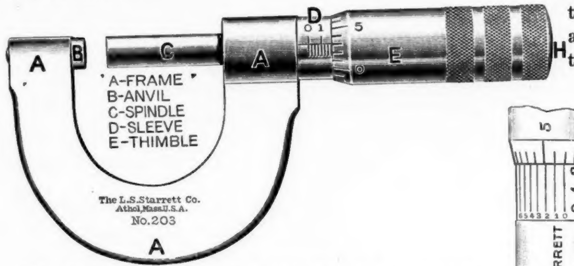
HOW TO READ A MICROMETER.

By Courtesy of The L. S. Starrett Company.

The spindle *C* is attached to the thimble *E* at the point *H*. The part of the spindle which is concealed within the sleeve and thimble is threaded to fit a nut in the frame *A*. The frame being held stationary, the thimble *E* is revolved by the thumb and finger, and the spindle *C* being attached to the thimble, revolves with it and moves through the nut in the frame, approaching or receding from the anvil *B*. The article to be measured is placed between the anvil *B* and the spindle *C*. The measurement of the opening between the anvil and the spindle is shown by the lines and figures on the sleeve *D* and the thimble *E*.

The pitch of the screw threads on the concealed part of the spindle is 40 to an inch. One complete revolution of the spindle, therefore, moves it longitudinally one-fortieth (or twenty-five thousandths) of an inch. The sleeve *D* is marked with 40 lines to the inch, corresponding to the number of threads on the spindle. When the micrometer is closed, the beveled edge of the thimble coincides with the line marked 0 on the sleeve, and the 0 line on the thimble agrees with the horizontal line on the sleeve. Open the micrometer by revolving the thimble one full revolution, or until the 0 line on the thimble again coincides with the horizon-

tal line on the sleeve ; the distance between the anvil *B* and the spindle *C* is then 1-40 (or .025) of an inch, and the beveled edge of the thimble will coincide with the second vertical line on the sleeve. Each vertical line on the sleeve indicates a distance of 1-40 of an inch. Every fourth line is made longer than the others and is numbered 0, 1, 2, 3, etc. Each numbered line indicates a distance of four times 1-40 of an inch, or one-tenth.

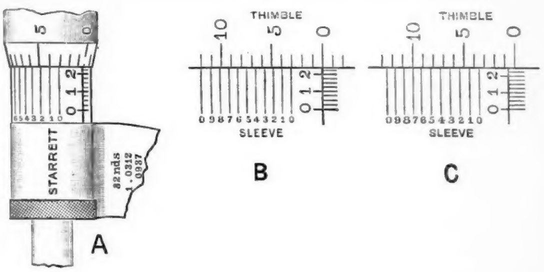


The beveled edge of the thimble is marked in twenty-five divisions, and every fifth line is numbered from 0 to 25. Rotating the thimble from one of these marks to the next moves the spindle longitudinally 1-25 of twenty-five thousandths, etc.

Twenty-five divisions will indicate a complete revolution, .025 or 1-40 of an inch.

To read the micrometer, therefore, multiply the number of vertical divisions visible on the sleeve by 25, and add the number of divisions on the bevel of the thimble, from 0 to the line which coincides with the horizontal line on the sleeve. For example, as the tool is represented in the engraving there are seven divisions visible on the sleeve. Multiply this number by 25 and then add the number of divisions shown on the bevel of the thimble, 3. The micrometer is open one hundred and seventy-eight thousandths. ($7 \times 25 = 175 + 3 = 178$.)

Readings in ten thousandths of an inch are obtained by the use of a vernier, so named from Pierre Vernier, who invented the device in 1631. As applied to a micrometer this consists of ten divisions on the thimble. The difference between the width of one of the ten spaces on the sleeve and one of the nine spaces on the thimble is therefore one-tenth of a space on the thimble. In engraving *B* the third line from 0 on thimble coincides with the first line on the sleeve. The next two lines on thimble and sleeve do not coincide by one-tenth or a space on thimble; the next two, marked 5 and 2, are two tenths apart, and so on. In opening the tool, by turning the thimble to the left, each



space on the thimble represents an opening of one-thousandth of an inch. If, therefore, the thimble be turned so that the lines marked 5 and 2 coincide, the caliper will be opened two-tenths of one thousandth or two ten-thousandths. Turning the thimble further, until the line 10 coincides with the line 7 on the sleeve, as in engraving *C*, the caliper has been opened seven ten-thousandths, and the reading of the tool is .2257.

To read a ten thousandths micrometer, first note the thousandths, as in the ordinary micrometer, then observe the line on the sleeve which coincides with a line on the thimble. If it is the second line, marked 1, add one ten thousandth; if the third, marked 2, add two ten thousandths, etc.

OUR OPPORTUNITIES.

Abstracts from an address to the graduating class of Stevens Institute of Technology by Mr. Walter C. Kerr.

"We hear much about opportunities. They are everywhere plentiful. Remember, that your opportuuity is the little one that lies squarely in front of you, not the larger one which you hope to find farther along. Many a man is surrounded with opportunities who never seizes one. There are traditions that Adam, William Tell and Sir Isaac Newton each had an affair with an apple, but with different results."

"Your first duty is always to that which lies across your path. The only step which you can take in advance is the next one. This leads to a simplicity of action which is commendable. Don't ramble."

"Cultivate singleness of purpose. This is more important than you may think. It is intuitive with the comparatively ignorant, and often absent in the highly trained. We are frequently surprised at the great competency of the ignorant contractor or foreman, on whom judgment is passed by saying that he is a practical man and gets results. Analysis will show that his best quality is singleness of purpose, which leads him to vigorously do the one thing before him without distraction following from knowing or thinking about too many other things."

"When you are getting what you go after, get it all. Avoid the mediocrity of compromise. Be thorough

and stand for full competency in everything, from main essentials to details."

"Much of our engineering is only done once, and it must be done right that once. A man who has learned by experience to do a thing deserves no credit for doing it right. He is then only a repeating machine. Real power is characterized by ability to perform right the first time that which a man never did before. Such performance involves the power to assimilate and adapt experiences, of more or less like or unlike kind, in a way to bring forth correct results. This is the true use of experience, wherein a man is a thinking, active power, and not a mere repeater."

"A point of view is involved in the power to rationalize. This is a thing which each man does for himself in his own best way, and its essence consists in asking one's self whether the thing is reasonable. It is a great check upon error. It is the power of the human mind, after performing in more or less systematic and conventional ways, to stand off and look at results and ask one's self whether they are reasonable. One man will figure that certain material weighs two hundred tons, and believe it. Another will say that there is something wrong in that, for it all came on two freight cars."

"It is well for a young engineer to cultivate his vocabulary and learn to use words in their right sense. They are then usually understood, even by those who have less knowledge. . . . . . Engineering documents, specifications aad letters are full of m sstatements due to the careless use of language. Conciseness cannot be overestimated. Brevity is desirable, but not at the expense of clearness. Conversely, a certain degree of facility should be acquired in reading the words of others."

"One of the worst attributes in engineering, and which is fundamentally born of conceit, tends to fasten error, censure and responsibility on others. There are times when a man needs to stand himself up in front of himself and ask; 'What is the matter with me?' The capacity of any man to admit his own error and frailty of judgment is a measure of strength rather than weakness."

"When you start your practical work, you will doubtless try to improve things. That is a legitimate purpose, if not overworked. I am not going to attempt to tell what needs improvement, but the one improvement that things need is in the line of sufficiency. You can think this over for yourself and apply it where it fits."

Remember that all the good you accomplish is going to come out of yourself. You cannot borrow it and you cannot make it out of that which has been poured into you by education or otherwise. All that you receive is only a certain quantity as knowledge, acquired by education, experience or other training, which will have a certain influence upon what comes out of yourself as your own. It is the inherent capacity to perform with your own brain which will make you what you become, and not the mere transmission of that which you have acquired. . . . . . Some have gone through experience without acquiring it, and many a man who has received an education has not got any because he allowed it to be a thing apart from his personality, and it slipped away."

American Electrician.

TOOL MAKING FOR AMATEURS.

ROBERT GIBSON GRISWOLD.

V. Special Tools for Lathe Use.

There are many special forms of tools for lathe use, the designs of which had their origin in some particular difficulty experienced while using the common or straight tool. This is especially true of the special spring thread tool about to be described. Many of the readers have doubtless experienced difficulty in cutting smooth threads on the lathe, especially when the material was very tough or hard, or possessed both characteristics. It is almost impossible to get a perfectly smooth thread, no matter how keen the tool is kept or how carefully the tool is fed to the work. This difficulty arises from several causes, which may be: a slight looseness in the tool carriage or post, slight play in the head spindle, or the "springy" nature of the piece upon which the thread is being cut. The latter cause is, perhaps, most frequent, and results in the point of the tool digging into the work and then slipping, leaving the surface either torn and ragged or full of chatter or ripple marks.

The spring tool illustrated in Fig. 1 was primarily designed to overcome the tendency of the tool to dig in, and just how well it performs this function may be realized when the reader is told of a four-inch, double-threaded tap made very recently of a high grade tool steel in which the last or finishing cut left the surface of the thread so true and smooth that perfect reflections could be seen in it of objects held close to it. Repeated attempts had been made to finish it with the ordinary straight tool for roughing out the thread, but to no avail, for no matter how slowly the work revolved or how much lubricant was added, the chattering would persist. The writer has seen some remarkable finishing cuts taken with just such tools, especially when the edge is ground so that it stands at an angle to the horizontal plane through the center of the piece. This will take a shearing cut and leaves the surface remarkably smooth. There may be those who will differ with the writer in this, but he is speaking

from an extended experience with some very high class work in which this tool only could be used to secure the desired result.

The shank *a* is forged from a piece of tool steel to the general outline shown, but without the hole *b* or slot *c*. The rough forging is first finished all over; then the hole *b* is drilled with a ⅜ in. drill and the slot *c* cut with a milling cutter if possible, or with any other means that the amateur may find at hand. A ¼ in. hole is then drilled in the end *d* to take the tools *e*. This hole should be reamed so that the tools will be a snug fit therein. A small set screw *f*, bearing on a flat in the top of the tool *e* serves to bind it firmly in place. After all work is done on the tool it is hardened and the piece drawn to a spring temper. The tempering of the points *e* needs no special mention.

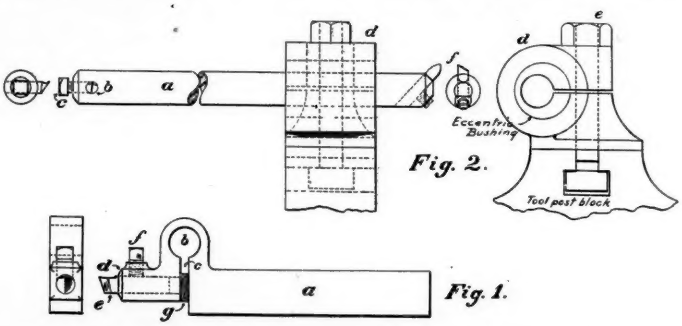


Fig. 2.
Fig. 1.

When in use, unless on very light work, a small block of wood, such as a piece of cherry, is fitted in between the sides of the slot, as at *g*, which prevents too great vibration, and yet is yielding enough to allow the tool to recede slightly from the work when a hard spot is run into. Then, when the same spot is reached again, the tool will not back off as much and the piece will be finished very smoothly. Other points besides the thread cutting tool may be used with equal facility.

Probably many of the readers have experienced some difficulty in boring out cylinders of any great length on a small lathe, owing to the spring of the tool when cutting so far away from the point of support. The cut must be very light and the feed very slow if even a fair job is expected. To overcome this difficulty a boring bar having great rigidity is used.

The bar, Fig. 2 *a*, may be made of a piece of ¾ in. machinery steel for nine and eleven inch lathes, and perhaps a 1 in. diameter for a thirteen in. lathe. The greater stiffness possessed by this bar the better work will it perform. This bar should be provided with a ¼ in. or ⅜ in. hole in each end as shown, for the reception of the various points to be used with it. A set screw is also provided for clamping the point firmly, and these points may be cut from a piece of Stubb's drill rod, ground to shape and hardened, no forging being necessary. After the bar is finished as smoothly as possible, and of even diameter throughout its length, it is case-hardened. This process is accomplished by heating the piece in a length of iron pipe about two inches in diameter and five inches longer than the bar. The bar is placed in the center and packed all around with a mixture of charcoal and bone-dust, or in place of the latter scraps of old leather mixed with a little ferro-cyanide of potassium. The ends are stopped with clay, and the whole put into a fire and heated to a cherry red for four of five hours; the bar is then removed and plunged into water, care being exercised to lower the water in a vertical position, quickly, and afterwards rapidly agitating the water by moving the piece to and fro. This should prevent the bar from warping, as it most certainly will if dropped in sideways.

The hole *f* is put in at an angle in order that a point may be used up into a corner. Thread points may also be used for cutting internal threads. Of course the size of the bar limits the diameter of the hole to be bored to slightly more than its own diameter, plus the length of point protruding from the side. For smaller holes than this it is well to have a half-inch bar with a large shank or a split bushing to fit into the clamp *d*.

The clamp *d* is made of cast iron and fits the tool post block. The same bolt *e* that secures it to this block also serves to clamp the bar firmly. The block *d* should have a tongue fitting into the tool-post slot which will prevent it from turning when the tool begins to take a cut. As the feed screw forces the tool into the work there is a great sidewise pressure which tends to twist the block *d* and thus relieve the pressure. It should always be remembered in boring that the tool support should be as near the cutting point as possible, as every bit of overhanging bar that is unnecessary gives the bar just that much greater tendency to spring.

The excavations at Pompeii have brought to light a piece of bronze wire rope nearly 15 ft. long and about 1 in. in circumference. The rope is now in the Musio Borbonico at Naples.

HOW TO BUILD A POWER LAUNCH.

CARL H. CLARK.

I. Laying Out the Lines.

The launch to be described is of a type which has lately become very popular among users of launches. It is 21 ft. long, 5 ft. 8 in. wide, and draws about 2 ft. of water. It is a very comfortable boat for pleasure sailing, as, while sufficiently seaworthy to endure severe weather, it is not so large as to require a large, heavy and expensive engine with the consequent heavy expense for fuel. The small cabin will shelter five or six people in a shower, or will afford comfortable cruising accommodations for three. The cabin, if not required, could be omitted and the awning and seats run forward instead. The boat is exceptionally roomy for one of her size and is of very easy form, which materially lessens the labor of building and brings it within the scope of amateur builders.

While the building of this boat is more complicated than any of the others which have appeared in these columns, there is no reason why any amateur who is used to tools should not be able to build it, especially if he has followed the previous descriptions and, perhaps, built some of the boats outlined therein. It is hoped that even those without previous experience in boat building will find the directions entirely clear.

Plate 1 gives the usual drawing of the "lines" as they are usually given to boat builders. These will be familiar to all from the previous descriptions, and the first work will be to reproduce, in full size, as much of this drawing as is necessary to obtain the shape of the various moulds used in the building.

The first step will be to lay out the outline of the keel and stem and of the moulds full size on a smooth floor. This is accomplished from the dimensions given in the "laying off table". The space chosen must be at least 22 ft. long and 6 ft. wide. A base line is drawn near one edge, and care must be used to have this line straight, which can be done either by snapping it in with a chalk line or by stretching a thread and marking several points and connecting these with a straight edge. It is very convenient to fasten a straight batten with its edge at the base line, thus enabling measurements to be laid off more easily, as the end of the rule may be placed against the batten, with the certainty that it is always even with the base line. The l. w. l. is next laid off 2 ft. 3 in. above the base line and parallel with it, water lines 1*a* and 2*a* are drawn 4 and 8 in. above the l. w. l., and water lines 1*b*, 2*b* and 3*b* are drawn 4, 8 and 12 in. below it and parallel with it. The cross sections, or mould lines, are drawn square with the base line and 2 ft. and 6 in. apart, numbering them as in the drawing. This drawing may, if desired, be done on a large sheet of paper one 5 ft. wide being sufficient, with the base line at its extreme edge. For drawing curved lines a batten, of pine or other flexible wood, about ½ in. square will be required; it is held in place by small wire nails driven through it into the floor. The outline of the keel bottom is first obtained from line 3 of the laying off table, by laying up from the base line on each mould line the distance given under the number at the top; for instance, on mould line No. 1, we should set up 1 ft. 9½ in,; on No. 2, 9 in.; on No. 3, 7 in. and so on. It will be noted that the keel is straight from the after end as

TABLE OF OFF-SETS.

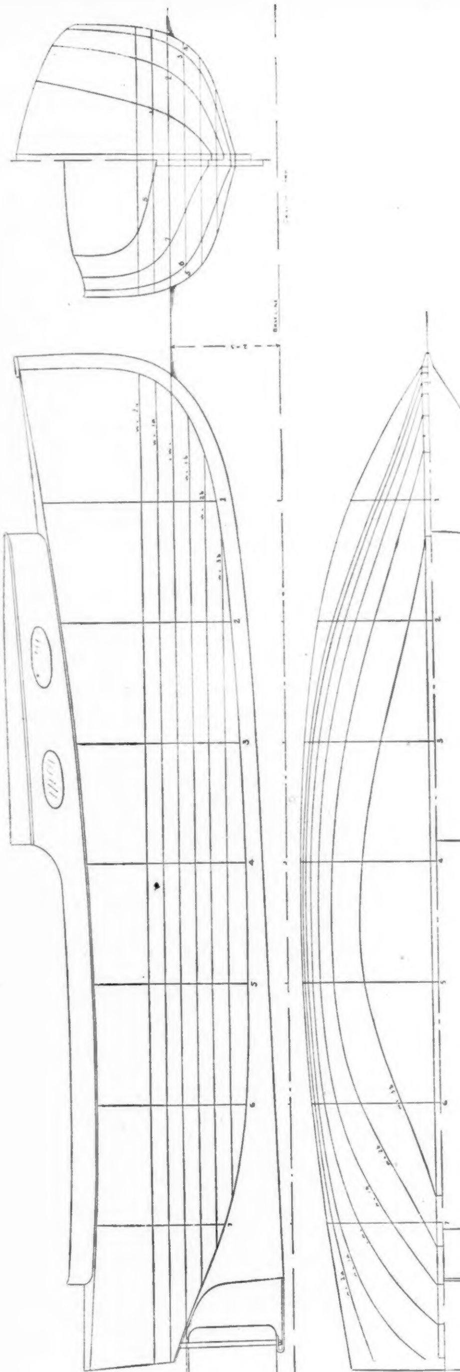
	Numbers of Moulds.							
	1	2	3	4	5	6	7	Stern
Ht. of sheer line above base line	5' 0"	4' 7⅝"	4' 4⅛"	4' 1⅞"	4' 0¾"	4' 0¼"	4' 4"	4' 3⅝"
Ht. of rabbet line above base line	1' 4⅛"	1' 1"	0' 11⅝"	0' 10⅛"	0' 10⅛"	1' 11¼"	1' 4⅞"	2' 6¼"
Ht. of keel bottom above base line	1' 0½"	0' 9"	0' 7"	0' 6"	0' 5"	0' 4"	0' 3"	2' 5"
Half breadth on deck	1' 8"	2' 4¾"	2' 8½"	2' 10"	2' 10"	2' 8¼"	2' 4⅞"	1' 11⅝"
Half breadth on w. l. 2*a*	1' 2"	2' 1⅝"	2' 7¼"	2' 9⅝"	2' 9⅝"	2' 7⅝"	2' 3½"	1' 6"
Half breadth w. l. 1*a*	1' 0¾"	2' 0"	2' 6½"	2' 8⅝"	2' 8⅝"	2' 6⅝"	2' 1⅝"	0' 4¾"
Half breadth l. w. l.	0' 11⅓"	1' 10¼"	2' 5"	2' 7½"	2' 7½"	2' 5"	1' 8½"	
Half breadth w. l. 1*b*	0' 8½"	1' 7⅝"	2' 2¾"	2' 5½"	2' 5½"	2' 2"	1' 0½"	
Half breadth w. l. 2*b*	0' 5¼"	1' 2⅝"	1' 10½"	2' 2"	2' 2"	1' 7⅞"	0' 4¼"	
Half breadth w. l. 3*b*		0' 5⅞"	1' 1½"	1' 6½"	1' 6½"	0' 9⅞"		

TAKING OFF TABLE

Water lines are spaced 4" apart. Moulds are spaced 2' 6" apart. Base line is 2' 3" below l. w. l.

TABLE FOR LAYING OUT STEM.

		Rabbet.	Face of stem.
Deck		2 ft. 8½ in	3 ft. 0 in
W. l.	2*a*	2 " 7½ "	2 " 11½ "
W. l.	1*a*	2 " 5⅝ "	2 " 9¾ "
L. w. l.		2 " 2½ "	1 " 7⅜ "
W. l.	1*b*	1 " 9 "	2 " 3¼ "
W. l.	2*b*	1 " 0 "	1 " 9⅝ "
W. l	3*b*		0 " 11¼ "



far forward as No. 3 when it begins to curve upwards and merges into the curve of the stem.

The outlines of the outside of the stem and the rabbet in the stem are next to be laid off; these are obtained by setting out horizontally from mould station No. 1 on each waterline the distances given above.

The top of the stem is 5 ft. 5½ in. above base line, and this height will first be laid off; then the distance 2 ft. 8 ½ in. from the table will be measured off horizontally from mould station 1 at this level for the upper end of the rabbet line, and 3 ft. 9 in. for the upper corner of the stem. Coming down now to w. l. 2*a*, the distances 2 ft. 7½ in. for the rabbet and 2 ft. 11½ in. for the face of the stem are laid off in the same way along w. l. 2*a*, and so on until all are measured off. The two curves are then struck in with a limber batten, the outer one joining that of the keel bottom already drawn.

The rabbet line is next laid off from the dimensions of line 2 in the table, in the same manner as the keel bottom. It crosses the l. w. l. 2 ft. 1¼ in. back from mould No. 7 and ends on the stern 2 ft. 10⅛ in. back from No. 7 and, as noted in the table, 2 ft. 6¼ in. above base line. The curve can now be drawn in, joining that already drawn at the bow. It remains now to draw in the outlines of the stern post. The end of the stern post is on such an angle that if it were continued to the l. w. l. it would cut it 1 ft. 3½ in. back from No. 7. The outline of the under side of the overhang should run along about ¾ in. below the rabbet and curve into the straight of the stern post, as shown in the line drawing. The line giving the angle of the sternboard should also be drawn, the top of it being 4 ft. 3¾ in. above the base line, and 5 ft. 9 in. back from No. 7.

The shape of each mould is now to be laid out from the table. The base line, water lines and a center line square with them, as laid out; turning to the table and taking mould No. 4 as an example, we find the height at sheer line from line 1 to be 4 ft. 1⅞ in., and the half breadth at the deck height from line 4 to be 2 ft. 10 in. These two locate the upper end. Coming down to w. l. 2*a*, we find the half breadth in line 5 to be 2 ft. 9⅝ in. and on w. l. 1*a* from line 6 to be 2 ft. 6⅝ in. and so on for the remainder of the water lines.

Since the mould line ends at the rabbet line, the height of the rabbet line 2 will give the lower end of the mould line, and as the keel is 3 in. thick, this lower ending will also be 1½ in. out from the center line. The remainder of the moulds and the stern outlines are laid out in the same manner. As the "lines" are laid out to the outside of the plank, and we desire our moulds to the inside. we must take off the thickness of the plank, ¾ in., parallel with the outline just drawn. It is to this outline that the mould is to be made. It will be noticed that Nos. 4 and 5 are alike except in the height at the upper end,

thus enabling one pattern to serve for both.

A pattern or mould of thin stock is to be made, of the stem, keel and deadwood, to the form laid out on the floor. It should be of the shape enclosed by the keel bottom and the rabbet, one edge representing each. The same is true of the stem mould, the outside edge representing the face of the stem, and the inside representing the rabbet. The stem mould should be joined to the keel mould in the proper position, and well braced so that it may be carried abont without danger of springing out of shape. A short piece also should be fastened at the after end to show the angle of the stern board. A mould must also be made to the shape of each cross-section. They are made of rough stock and are, of course, double for both sides; they must be strong and well braced as they are depended upon to hold the shape of the boat during building.

The next issue will deal with the getting out of the keel and stern and setting up the boat.

SMALL FLASH BOILER.

H. D WATERHOUSE.

Flash boilers are of very small size for the power which they are capable of generating. Their value is due to the very high working pressure, and the instantaneous generation of steam, and light weight. Boilers of this type are capable of such power only because the entire energy of the fire is used on the volume of steam required at the particular moment of intake of the engine. They do not keep a mass of water under steam for the sake of what the engine may require at any particular moment.

They are, however, unable to respond to sudden abnormal demands for power, because they have no considerable amount of super-heated water ready to burst into steam at once. That is to say, they do not contain any amount of stored power, as in the ease of the ordinary tubular boiler. For this reason the fire must be very closely regulated according to the amount of power needed.

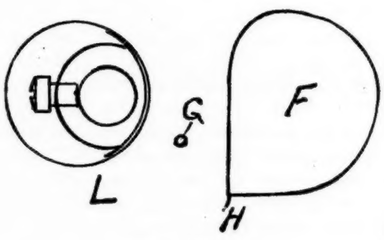
In the construction of the boiler here described the materials necessary are: — 20 ft. of seamless drawn copper pipe, ⅛ in. iron pipe size, and walls 1-16 in. thick; also six brass couplings, 1-8 in. iron pipe size. These are sizes in name only, the pipe being actually a little over ¼ in. internal diameter.

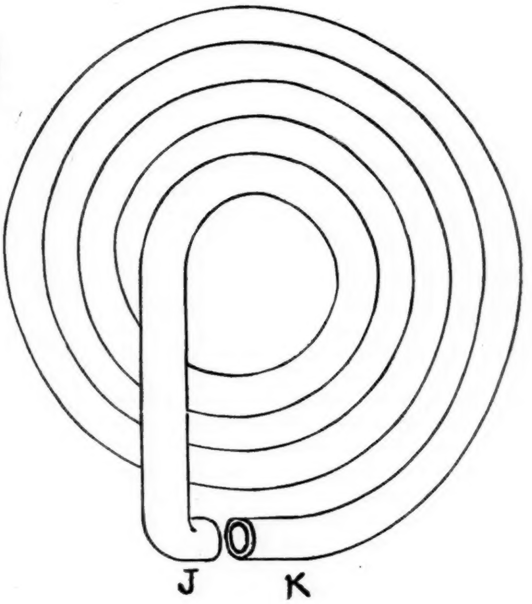
A force pump of small diameter is also needed; if one is not at hand it may easily be made. First make a piece of wood *F* of the shape and one third larger than the drawing. Nail this in the middle of a piece of board. Take one end of the copper pipe and lay it against the straight side and drive a nail in to hold it at *G*. About 2 ½ in. of pipe should be left for connections from the point *H*. Make a mould of wood for casting a strip of lead ¼ in. wide, ½ in. high, and about 5 ft. long, with a little taper at one end. Next make one turn of the pipe around *F*, then place the tapered end of the lead strip between what would be the two inner sides of the first and second turns of pipe, and wind on the pipe and lead strip, keeping the lead strip placed with smallest diameter always between the turns of pipe. Make three concentric turns of the pipe and bring the ends together at the same side of the coil as in the elevation drawing.

Thread the ends and bend to the proper angle. The beginning of each coil *J*, and the ending *K*, should be threaded respectively with a right and left hand thread, fitting couplings. Make five coils in this way, pue join tight with couplings. The boiler is then complete except for threading, at the delivery end, a steam gauge. safety valve and throttle. The intake end of the boiler is connected to the delivery of the force pump. The coils are then mounted in a shell or casing made of heavy sheet iron in two layers with a thick layer of asbestos between. The burner, which should be for gas, gasolene or kerosene is to be mounted under the coils. The pump is made as in drawing, No. 2; i. e., just an ordinary force pump with ½ in. piston, drivan by an eccentric on the engine shaft.

It differs, however, by having a spring between it and its eccentric of slightly less force than that in the safety valve. In this way only enough water is let in to make steam enough to pop the valve and no more, as when the steam is at that point, the spring *C* in the pump compresses, the collar *B* slides over the piston, and no water is forced ahead. The eccentric *L* is illustrated in the drawing, and has a ½ in. throw. It is located on the main shaft of the engine. The boiler may be heated in any way so long as there is heat enough. A good burner may be made by making coil of iron pipe like the boiler coil. This is for vaporizing the kerosene which is to be used for fuel. Underneath this is a coil of iron pipe single turn, in which very small holes have been drilled on the upper side about an inch apart.

To operate the boiler, pour a little kerosene in the base of the burner and let it burn out, this will heat the vaporizing coil. Now slowly turn on the kerosene which is under a pressure of about 15 lbs. and as it spurts up light it. When the lower tubes of the boiler get red hot, which will be in a very short time, give a few strokes of the pump slowly and steam will be raised to 300 or 400 lbs. pressure instantly. Then turn the engine over a few times by hand and open the throttle. The engine will then start. When engine is stopped the burner should be turned low.





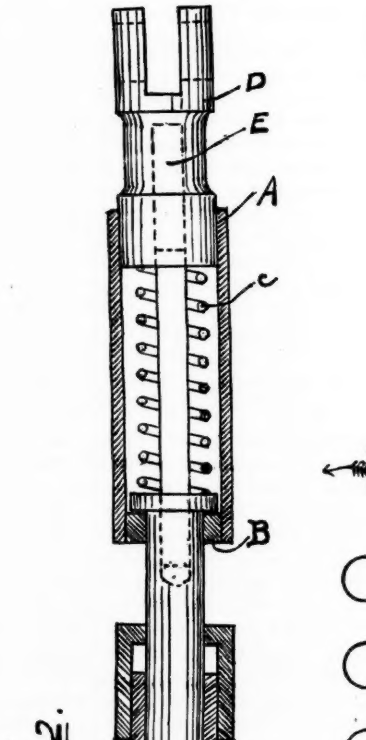


Fig. 2.

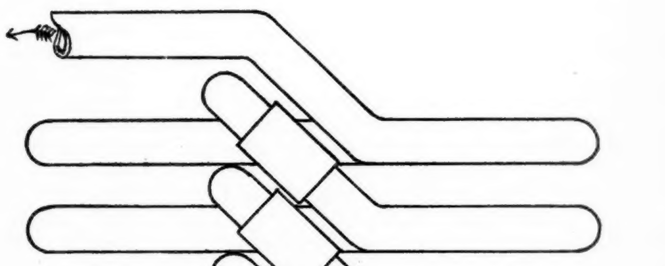


Fig. 1.
H. D. W.

SIMPLE ELECTRO-MAGNETS.

One of the first pieces of apparatus the amateur electrician desires to make is an electro-magnet. As some of the materials generally used are not obtainable except in the large cities, resort must be had to substitutes, of which those mentioned below can be obtained in every place in which a blacksmith shop is to be found.

For the cores the softest iron is necessary. Norway bar iron is the best kind to use, and in buying it be sure that it is iron and not a low carbon steel, as much of the so-called iron now sold is in reality steel and not iron. If Norway iron cannot be had, the next best is to apply to the blacksmith shop for some rivets of the required size. To ensure that these are as soft as possible they should be annealed by heating to a red heat in a stove or furnace, and then allowing them to cool slowly by packing in ashes.

A yoke is made from a piece of flat bar iron, holes being drilled of the right size to receive the rivets with a drive fit, and spaced the proper distance apart to allow of a slight space between the coils. Each coil must be insulated from the core. This is done by winding several turns of paper around a round piece of wood, which has been previously covered with soap, giving each turn of paper a coating of thin shellac. The soap prevents the shellac from attaching the paper to the wood. At each end of the paper tube thus formed attach with shellac a piece of thin, round or square wood with a hole in the center just fitting the tube. Suitable pieces can be cut from a piece of cigar box wood. These ends are also coated with shellac, and the coil bobbins are complete.

One bobbin, with the wooden rod still remaining therein, is then mounted on an empty box, on the edges of which notches have been cut to hold the rod in position. A piece of wire bent to form a crank handle is then added to one end of the rod and the wire then wound on in even layers. Unless currents of considerable potential are to be used, no insulation of other than the wire covering will be be needed, thus allowing the wire to be removed for other uses, should the maker ever desire. To start the winding, bore a small hole in one of the ends, close to the paper tube. Put through the hole from the inside of the wire and then, slowly turning the handle, wind on the wire in even layers, back and forth, until the coil is wound, carrying the outer end through another hole bored in the other end piece at the proper place. The other coil is made in the same way, with the exception that the wire is wound in the *opposite direction.*

The two coils can now be placed on the cores, first coating the latter with shellac, which will hold the coils firmly in place. The ends of the coils having the inside ends of the windings should be placed next to the yoke, and these ends connected. The outer ends of the windings can then be connected with the current supply, and the magnet is in working order. For magnets which are to be used for simple experiments, No 20 to 24 gauge wire is about right; larger wire uses up the battery too rapidly.

PHOTOGRAPHY NOTES.

Production of Duplicate Negatives.—To produce a negative of equal size from a negative, the Eder-Pizzighelli formula is for the amateur probably the simplest. For this purpose an ordinary thin film is bathed for two minutes in a solution of

Bi-chromate of potassium	10 gr.
Water	250 gr.

and the same is thus left suspended in the dark room to dry. The negative, which we obtain later on upon the film, is reversed. The application of films instead of plates has the advantage that, when printing the duplicate negative it can be inserted from the reversed side and a correct print can thus be obtained. After the chromated plate has become dry it is printed under the negative to be reproduced. Expose until the details of the picture can be seen and then wash for an hour. Now put the film into one of the usual developer solutions—hydrochinon, pyrogallic acid, or oxalate of iron, and thus a negative is obtained. The process is, that the exposed parts thrust off the developer solution, as the same acts only upon picture parts of very little or no exposure. Finally, the plate is put into a fixing soda solutien and washed as usual.

To avoid halos on interior exposures, when windows are in the line of the objective, the following method is recommended. To avoid the over exposure of the window, particularly when a fine landscape is visible through the open window, make first a short exposure for the window. Close now the shutters and darken the room as much as possible and make a flashlight exposure of the interior without changing the position of the camera. The natural and artificial illumination should, of course, agree as much as possible. If the plate is now developed, it will be seen that landscape through the window and interior have obtained the correct exposure. In case there are no shutters the interior exposure may be done after nightfall. If plates are used for this work which are strongly colored yellow in the emulsion, a satisfactory picture will be the result.

A new and ingenious piece of mechanism has been devised by the secretary of the London Hospital for a purpose not unfamiliar at that institution. A clock-face, bearing a statement that the hospital costs one penny per second to maintain, and inviting the visitor to take the entire cost of the hospital on to his shoulders for one second, contains a small automatic machine by which the clock-hand is advanced one second when the penny is dropped in. The secretary hopes shortly to add a grammaphone, which shall say "Thank you," in the King's voice for every gift.

SCIENCE AND INDUSTRY.

The bituminous coal measures at Coleman, N. W. T., are of the largest size. In Pennsylvania the largest in the famous Connelsville mine is 6 feet thick, while one of the seams at Coleman is fully 18 feet in thickness. The Coleman mine is clean, being free from slate and other foreign substances and especially adapted for cheap mining for several generations. Unlike the Pennsylvania coal, the coal at Coleman can be mined and extracted by gravity, compressed air being utilized in hauling the cars. As the mines will be self draining no pumping plant need be maintained.

Consul Frank Mahin transmits from Nottingham. England, the following information relative to a new cloth fireproofing material:

In a paper read at a meeting of a society of dyers in Manchester, titanic acid (the oxide of litanium) was claimed to possess remarkable fireproofing properties, and evidence was produced in the shape of experiments by the reader of the paper. He took, for instance, some pieces of flannelette which had been treated with titanic acid, and put a lighted match to them. The incipient fire in the material smoldered and went out, refusing to burst into a flame. The experimenter claimed that all inflammable textiles could thus be rendered fireproof. and that dyeing, boiling or washing would not remove the acid, it becoming, in fact, an integral part of the fabric.

A radium clock which will keep time indefinitely has been invented by Harrison Martindale, of England. The clock comprises a small tube in which is placed a minute quantity of radium supported in an exhausted glass vessel by a quartz rod. To the lower end of the tube, which is colored violet by the action of the radium, an electroscope formed of two long leaves or strips of silver is attached. A charge of electricity in which there are no beta rays is transmitted through the activity of the radium into the leaves, and the latter thereby expand until they touch the sides of the vessel, connected to earth by wires, which instantly conduct the electric charge, and the leaves fall together. This simple operation is repeated incessantly every two minutes until the radium is exhausted, which in this instance it is computed, will occupy 30,000 years.

The *Lancet*, London, says editorially: "The unrestricted sale of articles made of celluloid, which is practically guncotton, for any purpose whereby such article is liable to come into contact with fire, should on no account be allowed. We believe there are other dangerous substances related to guncotton which go under other names and which are also used for similar purposes and should be likewise banned. It may be that the inflammability of celluloid is sometimes somewhat counteracted by the admixture with substances with an opposite tendency, but the difficulty is to distinguish the combustible from the incombustible. At all events, some warning should be inscribed on the articles made therewith, and they should be marked 'highly inflammable' or with some equally premonitory and protecting device. It is time, also, that the fire insurance companies should formulate and promulgate warnings and prohibitions in connection with their policies of insurance, in order to avoid vexatious questions as to compensation for losses sustained by the use and abuse of celluloid articles, after the manner of the by-laws of the railway companies in respect to the carriage of explosives. The dangerous use of celluloid is due in great measure to the fault of the public themselves."—*Literary Digest*..

The Gautemaulan turkey is the latest discovered foe to the cotton boll weevil, and the Department of Agriculture will at once begin the importation of these birds for distribution through the plantations of the infected zone. Secretary Wilson states that the Gautemaulan turkey feeds chiefly upon the cotton boll weevil. "Our agents in Gautemaula have recently discovered in their study of the life history of the ants and the boll weevil that the turkey is an enemy to the weevil, and it proposes to give it a trial in the United States. The turkey of Gautemala is smaller than our own variety, and is very tame. It is also very good for food. In fighting the weevil the department will spare no expense." Secretary Wilson denied that experiments with the ants imported from Gautemala had been disappointing. He said the study of the little ant would be continued as assiduously as ever, and that those brought to this country had met expectations.

Dr. Leduc, of the Facul e Medecine in Paris, has found a way of utilizing a current of electricity to produce insensibility, in place of chloroform or ether. A series of experiments on animals, dogs, rabbits and pigeons, where a current of from 10 to 30 volts, alternating 100 to 200 times per second, was directed to the back and top of the head, was found to produce insensibility without harmful results. The success of the experiment so encouraged Dr. Leduc that he determined to try the effect on a human being, choosing himself as the subjeet. The current pressure was raised to 50 volts. The electrodes. wetted with salt water to obtain a good contact, were applied, one to the forehead and the other on the back, in order to act on the brain and spinal cord. The operation lasted about ten minutes, at the end of which time insensibility was complete. The doctor says he felt none of the inconveniences which follow the inhalation of chloroform. As soon as the current was cut off the awakening was immediate, coupled with a sensation of vigor. Other experiments are about to be tried, in the hope of arriving at a happy solution of the problem of inoffensive ansthetiæcs.

Renew your subscription before you forget it.

JUNIOR DEPARTMENT

For the Instruction and Information of Younger Readers.

ELEMENTARY MECHANICS.

. A. COOLIDGE.

X. Compressed Air.

Fig. 35 represents a student lamp chimney which may be procured at a grocer's or hardware store, with a piston *P* just large enough to move easily in the tube. The piston may be cut out of cork or soft wood, and will work better if it is made to fit loosely and then wound with soft string to a fairly tight fit. A rod and handle *H* must be fastened to the piston *P*. This can be done by boring a hole not quite through *P* and fastening in with a long, slender screw.

EXPERIMENT XXXIV.

If the piston *P*, resting on the level of the water, is raised, as no air can pass through it, the space *O* below it will be either a vacuum or will be filled with water; we find the latter to be the ease, and also that the water will rise as long as the piston is lifted. Some force drives the water up after the piston.

EXPERIMENT XXXV.

Take the discarded bulb of some electric lamp and holding its tip under water, break it off with a pair of pliers. If a small hole is made the water enters in a little fountain shaped spray until the bulb is filled, The force driving the water upward in both of these cases is the weight of the air pressing upon the surface of the water and, as we have before learned in all fluids, changing its downward pressure into lateral and upward pressure; it drives all fluids before it and forces them to enter any spaces not already filled with other matter. Could our lamp chimney be made 34 ft. high, and be strong enough, the water would rise to that height and then refuse to go further. A tube of the same kind in a jar filled with mercury or quicksilver need be but a little over 30 in. long for a similar experiment and illustrates the action of a barometer We should make one for ourselves from a description published in the September, 1903 number of this magazine, to which readers are referred or, at any rate, study its construction from one already made.

It will be noted that the tube contains a column of mercury about 30 inches high. The space above the mercury is a vacuum, *i. e.*, it contains nothing except a very little mercury that has changed to a vapor. As the word barometer signifies an instrument for measuring air pressure it must be shown in a rise or fall of the mercury. f the air becomes heavier the mercury ises; if lighter, the mercury falls. But what causes any change in the airs' weight or pressure? Any change in the amount of vapor in the air causes [a change in the air pressure. A falling barometer indicates a storm, although many local distubances may occur without such a change in the weather. A rising barometer foretells pleasant weather.

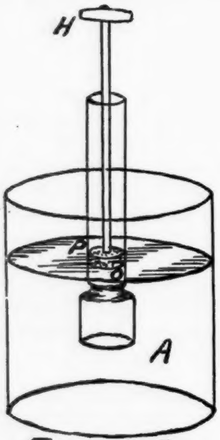


FIG. 35.

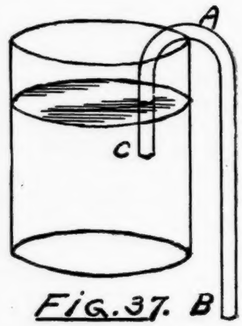


FIG. 37.

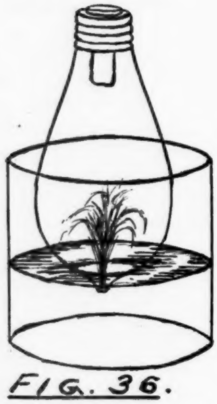


FIG. 36.

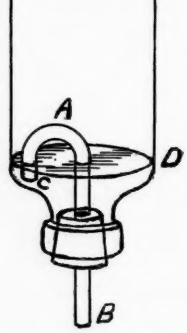


FIG. 38.

Another use of our barometer is to tell the height above the sea level of different places. As it is the weight of the air pressure upon the mercury in the cistern that balances the weight of the mercury in the tube, any change in the weight of air will make the mercury column higher or lower. Therefore, the higher one ascends, as in climbing a mountain or in a

balloon, the less air there is above, consequently the less will be the pressure or weight of the air on objects. The mercury in a cistern of a barometer will have less pressure on it the higher we ascend, and consequently the column of mercury in the tube will be shorter.

Suppose we should start at the foot of a high hill and with a convenient barometer ascend the hill. If the barometer column were 30 inches when we started, and as we climbed the hill fell to 29 inches, we should know that we had climbed a vertical distance of over 940 feet, and the barometer would register one inch less for every such distance we climbed.

On Mt. Blanc, about 3 miles high, the barometer is only 15 inches, and we see by this that the above rule for one inch fall holds good only for a short distance. We see also that if the barometer is only half its usual height on Mt. Blanc, that one-half the earth's atmosphere is within three miles of the earth's surface and that it is very thin above that distance. The distance in level of the top and bottom of a high building will show itself in a barometer.

A more convenient form, called an Aneroid barometer, in the shape of a small clock, is made. This is the form usually carried by mountain travellers. Some are even as small as a large watch. They have a single hand or index and contain within a small tin metal box from which the air has been exhausted. The air presses upon this box and shows an increase or decrease by moving the pointer of the barometer. The barometer's height in inches is marked on the dial, as the hours are marked on the face of a clock. Such a barometer can be carried in the pocket and is an instrument of much convenience and value to a mountain ciimber.

In some of our former experiments we used a piece of rubber tubing about two feet long. If we do not have one a three or four feet length of common garden hose will admit of the following experiment being tried on a larger, coarser scale. A glass tube, 12 inches long, as shown in Fig. 37, bent so as to have one arm longer than the other, will allow us to see better what takes place in the operation of a syphon.

Experiment XXXVI.

Fill the tube with water and with the thumb covering the opening *C*, put it down into a jar of water. There is more water in the arm *A-B* than in the other arm, *A-C*, consequently the greater downward force is in the arm *A-B*. The water in *A-C*, instead of flowing out at *C*, is forced by the air pressure to rise toward *A*, and this continues as long as there is water in the jar above the opening, *C*. With a rubber tube a tub or barrel may be emptied. Syphons are of great use in emptying barrels where there is a sediment in the bottom, such as vinegar. The liquid is drawn off through the tube without stirring up the dirt at the bottom.

A very interesting form of syphon is what is called an intermittent spring. In one of our former experiments we had a large-mouthed bottle with the bottom removed; with a small glass tube, bent as in the figure and run through a tightly fitting cork, our apparatus is complete. Water may be poured into the bottle without running out until it rises above the level *A*. Then it begius to run out at *B* and and continues to run until the leveal again reaches the opening of the tube *C*. It will then cease running until the level *A* is again reached.

An intermittent spring may be flowing in dry weather and dry in rainy weather, because, as the water in some natural reservoir has not had time to fill the cistern, and as it may not rise above the bend in the natural bent passage or syphon tube until long after the rain has ceased, the water will not begin to flow until the level corresponding to *A* in our figure has been reached. This may take so long after the rain that a spell of dry weather comes, and the reservoir may be so large that the water will continue flowing through a period of very dry weather, and ceasing to flow only about the time that another rain storm appears.

A DOLL HOUSE.

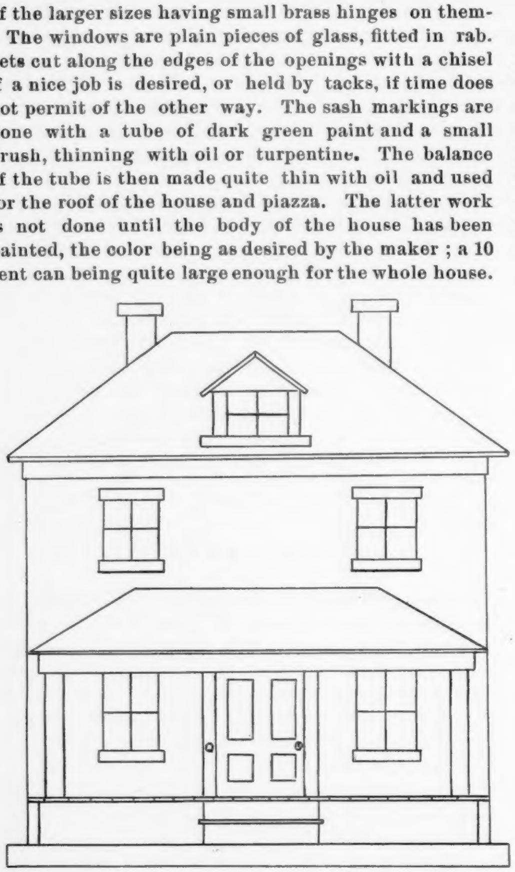
The younger readers of Amateur Work who may be able to use woodworking tools fairly well, and it is assumed that all are in possession of the tools more commonly used, will find the making of the doll-house here described excellent practice in fitting and giving much pleasure to the maker as well as to his younger sister, who will welcome it as a Christmas present *par excellence*.

The general dimensions are 22 in. across the front, 18 in. deep, 18 in. from the base to the eaves, the roof being 6 in. higher. A visit to the family grocer will nsually be productive of several boxes made of clear pine about $\frac{1}{4}$ in. thick ; those in which spices and seeds are packed serving nicely. The cost will not be great, however, if lumber is purchased of a lumber dealer, in which case get whitewood or pine $\frac{1}{2}$ in. thick, about 15 feet 9 in. wide being needed. Also, for the floors, 6 feet of $\frac{1}{2}$ in. stock 9 in wide will be needed.

The general desig is shown in the drawing and is made as one would make a plain box, after marking and cutting out the spaces for the doors and windows. The back of the house is made detachable, so that when playing it may be laid aside, opening the whole interior at the rear. In marking out the doors and windows, have them of rather large size, that observers or others of sister's playmates may participate in the play. A fret saw will be found handy for this work, but lacking one bore holes in each corner end use a key-hole saw, smoothing up the rough edges with a sharp knife or file. The joints of the hip-roof must be bevelled, and some fitting will be necessary to get good joints. The piazza is added after the rest of the work is done. It is all then mounted on a flat board 24 x 20 x $\frac{3}{4}$ in. Hinges for the front door can be made of cloth, or taken from a cigar box, certain kinds

of the larger sizes having small brass hinges on them.

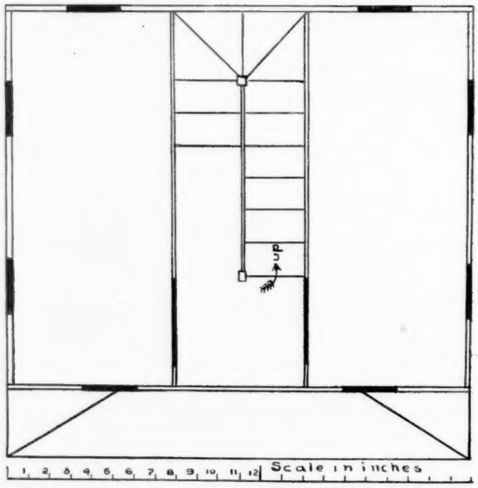
The windows are plain pieces of glass, fitted in rabbets cut along the edges of the openings with a chisel if a nice job is desired, or held by tacks, if time does not permit of the other way. The sash markings are done with a tube of dark green paint and a small brush, thinning with oil or turpentine. The balance of the tube is then made quite thin with oil and used for the roof of the house and piazza. The latter work is not done until the body of the house has been painted, the color being as desired by the maker ; a 10 cent can being quite large enough for the whole house.



The interior partitions are made of pieces ol large cigar boxes or similar thin stock, the stairs requiring the thinnest obtainable. The size and step of the stairs are ¾ in. each. Round tooth picks or matches are used for the stair posts. The sills to the windows are also made from thin stock, as well as the floor and roof of the piazza. The front door is panelled by cutting down with a narrow chisel or carving tool, a glass bead put on with an escutcheon pin serving for a door knob. A similar arrangement at the side can be made to press against a thin strip of brass, closing a circuit and ringing an electric bell, the cell from a night lamp battery and a small "buzzer" completing the outfit. The chimneys are made of strips of cigar boxes wrapped with red paper, and the bricks marked out with white paint or white India ink, if one has a drawing pen, fastening in position only when completed.

Should the reader desire a more pretentious house, one twice or three times the size given can be made, and other features can be added, such as electric lighting from miniature lamps with current supplied from the home main or by battery,

According to Sven Hodin, the explorer, the Chinese invented the process of making paper. On one of his journeys to the interior of China he found evidence that paper of a very fair quality was in use by the Chinese in about 275 A. D. There is a mill standing in the province of Chilitung where paper was made in 289 A. D., and in the village of Langtikiang, in a suburb of Canton, the ancient town of Kwangtiu, Mr. Heddin discovered a hand mill where paper was made from tree leaves several hundred years before Christ. But this process was very expensive, and the product was used only by the very wealthy. He secured one ancient



document written on paper made in this hand mill. The date of the document is 346 B. C., figuring on the time of the Chinese calendar.

Some surprising results are said to have attended a series of investigations made by a medical man in the mining districts of Upper Silesia. The curiosity of the doctor was aroused by the fact that among the many illnesses prevalent in his district lung diseases occupied proportionately a very low place, and that consumptive persons on coming to reside near the coal mines recovered their health after some time without any special cure. These facts he is prepared to verify by statistics. The cures are attributed by him to the coal dust contained in the atmosphere, which he alleges has a drying and disinfecting influence on tubercle development in the lungs. It is now proposed to erect a sanitarium for consumptives in the district referred to, in order practically to test the efficiency of the new cure.